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The Hewes & Phillips Iron Works' Practice in Compound Engines.

The illustrations which we present with this may be taken to fairly represent, somewhat in detail, the practice in compounding of the well-known firm of the Hewes & Phillips Iron Works, Newark, N. J. A pair of compounds are shown in the perspective on this page, which arrangement is frequently desirable. When a single compound is advisable, the system is substantially the same.

The company named also build compound engines in pairs; that is, with cylinders side by side, separated sufficiently for convenience, with cranks at right angles; but they favor the tandem type, as illustrated. They believe the tandem to be a little more economical in the use of steam, and the first cost is undoubtedly less. The space occupied by the tandem is also less.

With the tandem compound the passage of steam from the high pressure to the low pressure cylinder is direct, no receiver being required, as when coupled at right angles; there is unquestionably some loss in the receiver. Of course, those who have investigated the subject understand that, with the tandem type, notwithstanding the cylinders are both working in line, and through the same connecting mechanism, the pressure is much more evenly distributed through the whole stroke than is possible with a simple engine.

In the system shown, both the high and low pressure cylinders are steam-jacketed, including the cylinder heads. There has always been difference of opinion amongst engineers as to the economy of the steam jacket; the argument of the manufacturers is, to quote: "The entering steam in jacketed cylinders, coming in contact with surfaces of high temperature, immediately begins its useful work, unattended by any fall of pressure, or condensation; the latter is the great evil to be avoided, for wet steam has many times the heat-absorbing capacity of dry steam. The condensation does probably take place as much in one case as in the other, but in steam-jacketed cylinders it takes place when it can do no harm, the water of condensation being returned to the boiler by suitable pumping apparatus."

In the Hewes & Phillips valve gear (see page 2) all the parts attached to the liberating mechanism move about a common center, which is the center of the valve stem; this makes the leverage a constant quantity in detaching, and consequently the impulse on the governor is correspondingly constant—an important factor in securing close regulation. The weight of the parts is supported upon an enlarged cylindrical surface on the valve stem bracket; this not only relieves the valve stem of this weight, of the strain of moving the valves and the wear incident to such weight and movement, but it facilitates the desired rapid closing of the valves.

The actuating edges of this valve gear are made of crucible steel, of octagonal form, and are so constructed that eight faces or edges, one after the other, can be presented for wear both on the driving and driven arm. It is believed that, with the possibility of so many edges being presented to wear, and with their convenient adjustment, these pieces are practically indestructible during the ordinary lifetime of the engine.

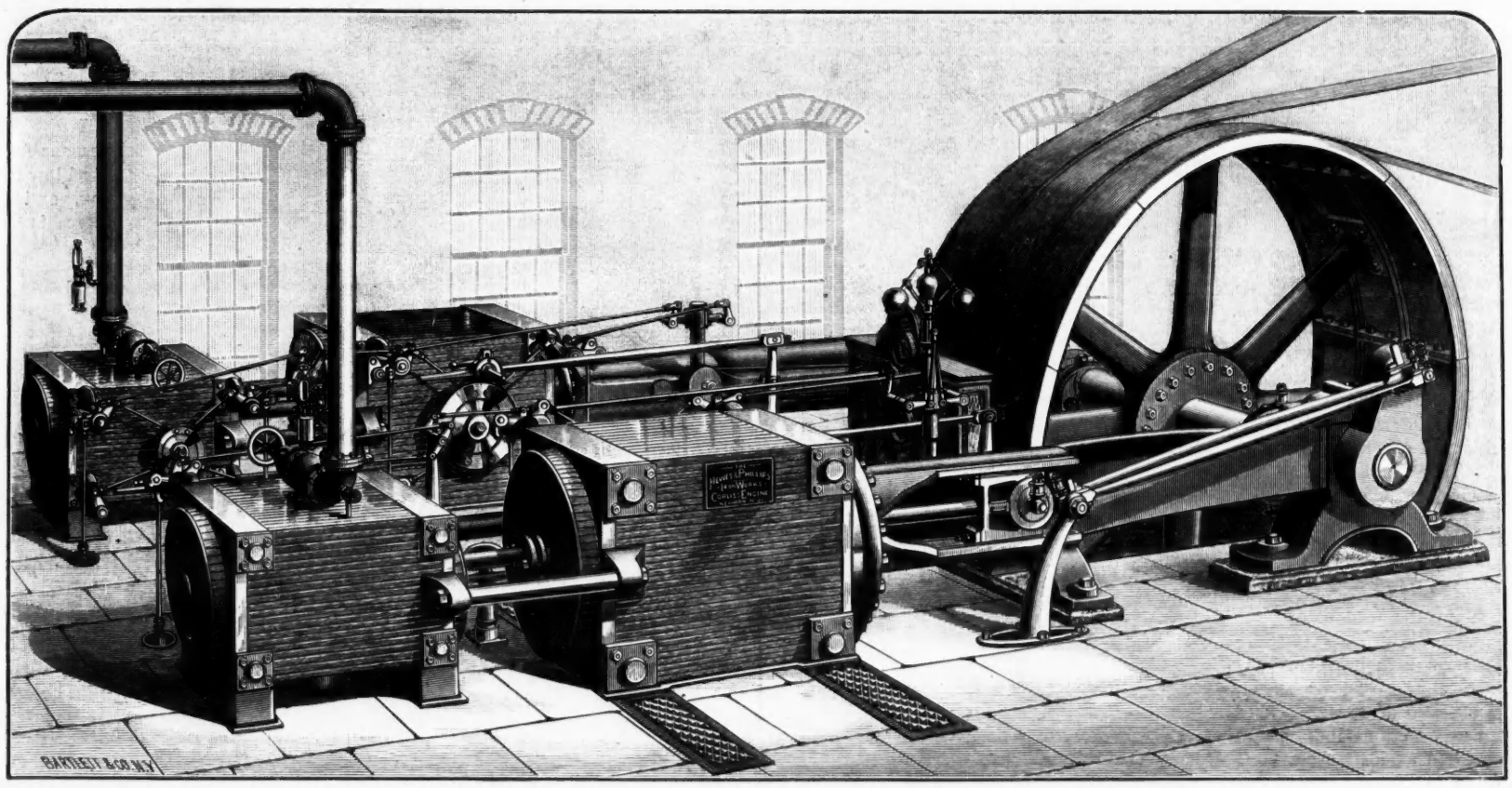
In explanation of the action of the valve gear it will be noticed in the detail engraving that an arm is adapted to swing on the valve stem bracket. This arm carries a piece of phosphor bronze, shaped like an inverted V at one end, the other end being connected to the wrist plate. The bronze piece mentioned carries the hardened steel octagonal piece; this is so arranged that the strain comes on a shoulder, and not on the bolt. This steel piece engages with a steel edge attached to a stud in an arm on the valve stem. The vacuum dash-pot is on the leg of the cylinder, and the rod from this is attached to the valve stem arm. The operation may be described as follows, referring to the detail engraving: The several parts are in engagement, the motion being in a direction to open the valve. Following the motion the V-piece will carry the valve stem arm along with it, opening the valve until it comes in contact with the hardened steel cam; this cam is secured to a bronze sleeve adapted to be rotated on the valve stem bracket. To this sleeve the cut-off rods from the governor are attached. Contact with the cam disengages the actuating edges, the vacuum dash-pot instantly closing the valve without shock or noise.

It will be observed that connection from the swing plate is made to the bell crank above the center; this causes the valve, in opening, to rotate outwardly, or away from the center of the cylinder, thus bringing the cut-off edge of the port in a direct line with the throttle valve opening; this arrangement avoids objectionable angles by which the steam must turn, with consequent reduction of pressure.

The condensing apparatus for these engines is of the Corliss type, the air pump being of the well-known single acting kind, universally commended for simplicity and effectiveness. The pump is brass-lined, and has brass brackets and guards; the air pump is drawn from an extension of the crank-pin, and the whole arrangement is specially designed to be come at easily for cleaning and repairs.

The details of crosshead are so plainly shown as to make description unnecessary.

The boiler, shown on page 3, is what is known as the Manning vertical tubular. The engraving represents one of five, each 180 horse-power, which the company are building for two separate compound engines with cylinders 16″ and 30″×48″, and 16½″ and 32″×54″. It is claimed for these boilers that they are very economical in the use of fuel, and require but little in the way of repairs. They are said to furnish dry steam, and are adapted for high pressure, being in this instance tested at 225 pounds. These boilers are made either with plain furnace, or with the Fox corrugated furnace, largely used for marine boilers.



PAIR OF TANDEM COMPOUND CONDENSING ENGINES.

In Michigan the following towns have either found natural gas or are drilling for it. Port Huron has five wells, Manistee has several wells, Grand Rapids, Coldwater, Owosso, Jackson, Adrian, Grand Haven, Wyandotte, Elkhart, Blissfield, Bronson, Tecumseh, Ypsilanti, Ann Arbor, Howard City, Michigan City, Monticello and Union. The fifth well put down at Port Huron is throwing out one and a half million cubic feet a day.

At this writing passengers to and from the West are getting full advantage of a railroad boycott. Owing to some petty quarrels, connecting roads refuse to recognize each other's tickets as usual, and passengers are put to much trouble and inconvenience The question is, will such a boycott be declared illegal? It is an interesting question.

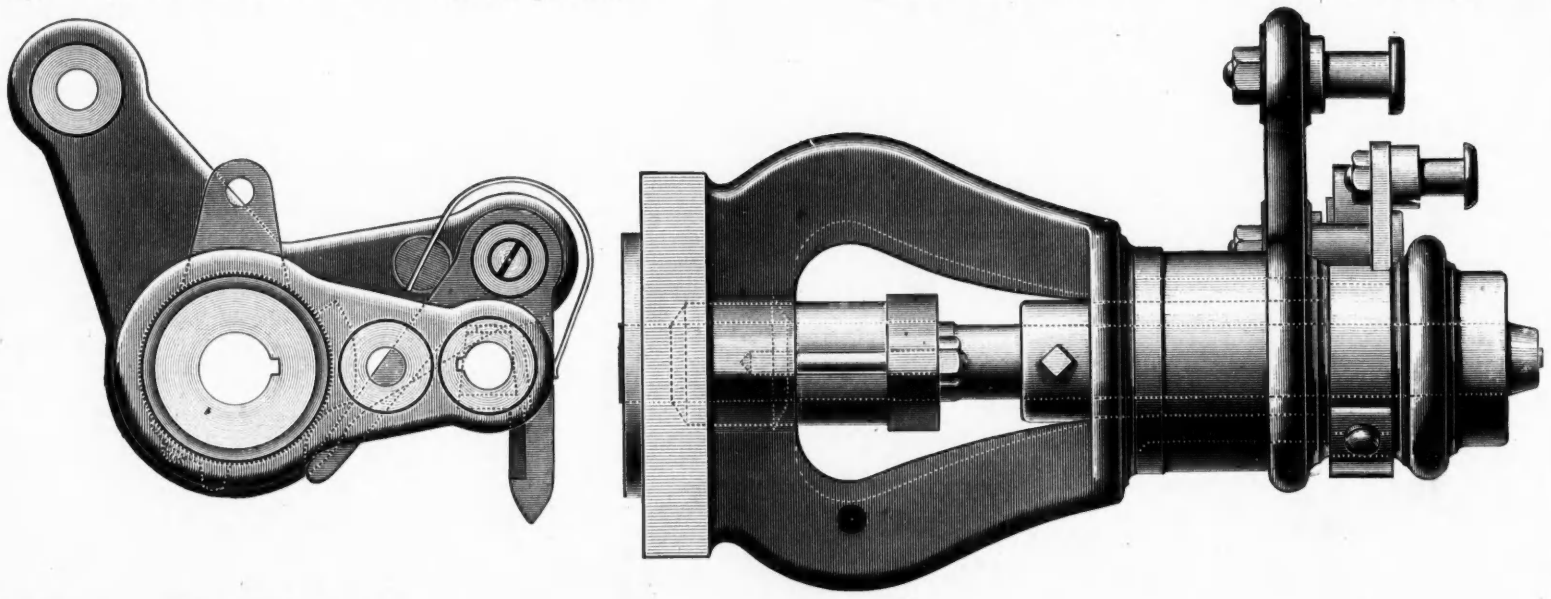
The Locomotive, published by the Hartford Boiler Insurance Company, says:

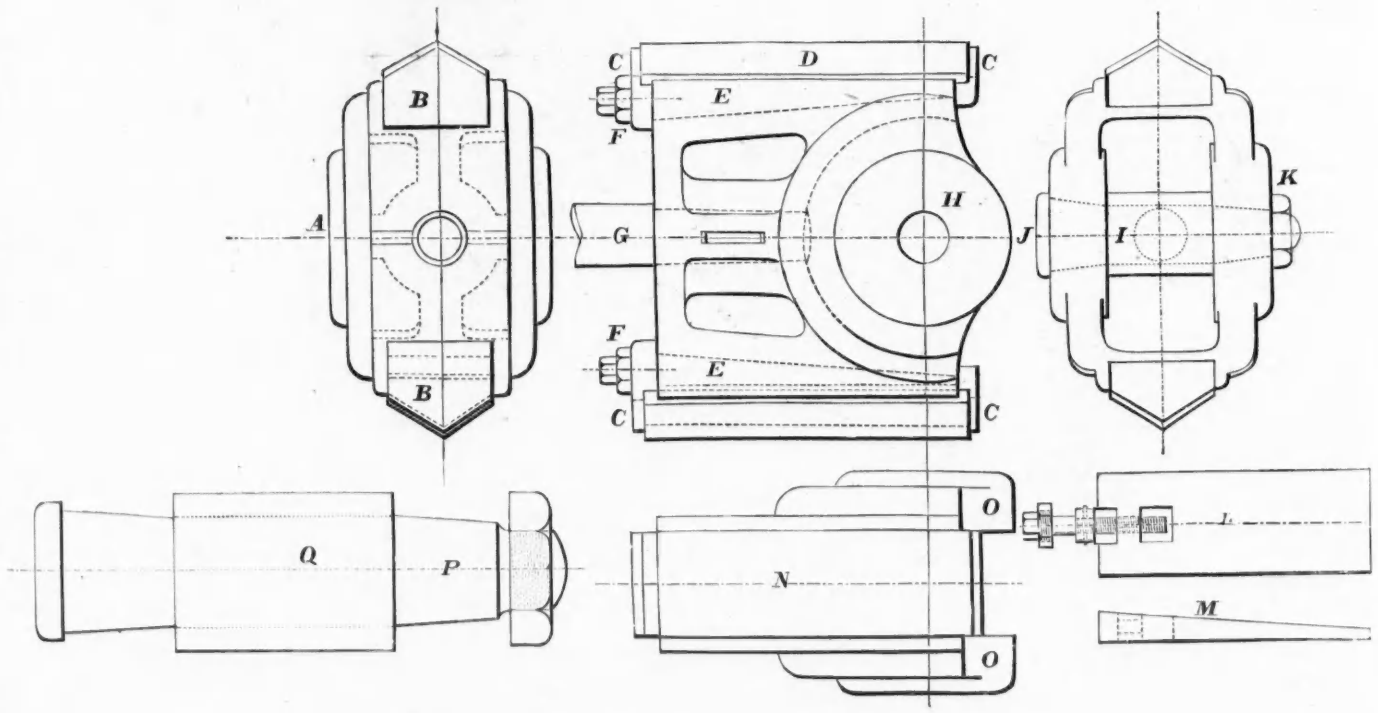
"In using oil of any kind to remove scale from steam boilers, and more especially where anything of the nature of kerosene or benzine is employed for the purpose of loosening it to facilitate its removal by mechanical means, great care should be used by the person so employing it, or he may be seriously injured. Accounts of serious accidents of this nature, resulting from carelessness or thoughtlessness, are frequently given in the newspapers, and without doubt many more happen which are not reported. Quite recently we received an account of an especially serious accident of this kind, a description of which may serve as a warning. The engineer and fireman were engaged in cleaning the boiler of the establishment in which they were employed. To loosen the scale they put a large quantity of a mixture of kerosene oil and benzine into the boiler, and then run it full of water, the object being to cover the inside of the boiler with the mixture, and so "cut" the scale. After letting it remain awhile, the water was drawn off, and the engineer lighted a torch and looked through the man-hole to observe the effect. Putting the torch through the man-hole into the boiler to enable him to see the interior, ignited the inflammable gas generated from the volatile mixture adhering to the shell and flues, and it exploded with great violence, throwing both men to the floor, and severely burning their hands and faces. At the time the report was written, it was feared that the engineer, who was the more seriously injured, would lose his eyesight, he then being entirely unable to see. It might be considered that the loss of eyesight by a man in ordinary circumstances would be quite as bad as instant death, so it will be seen that too great care cannot be exercised in the performance of such work.

"Serious accidents have also occurred from gas explosions of a different sort. Quite a number of cases are on record where boilers having stood empty for a while, with blow-off open, and in connection with a sewer or other foul place, have become filled with gas of some sort, which has ignited with such violence as to resemble an explosion and doing serious damage. An item in our last volume, on page 158, details an accident of this kind which nearly cost one of our inspectors his life. We would again urge, and insist that too much care cannot be exercised in such cases to make sure that everything is all right before introducing a light into the boiler."

The Pennsylvania Legislature is called upon to handle one of those questions which come up in connection with prison labor. The proposition is that the State pay for a plant of the most approved machinery for making, in the penitentiary, a special kind of mat in great demand. At present there are but three factories in the country where these mats are made, and these factories are in the stage of struggling into existence. If the State of Pennsylvania enters the list as a competitor with these struggling industries, there is no doubt that, with the people's money, no taxes to pay, and convict labor, it can wipe them out.

The Otto four-stroke cycle is a special feature of the Otto gas engine. This was recently the subject of litigation against infringers in Germany. The suit was brought by the Gas-Moteren-fabrik Deutz of Detuz, owner of the Otto patents in that country, against Moritz Hille, of Dresden, and several of his clients. The decision is in favor of the plaintiff, and orders are issued to discontinue the manufacture and use of the machines, also to account for damages. It is said that some large sizes of Otto gas engines have been furnished to city waterworks and electric light stations.





Details of Compound Tandem Engine.—See Page 1.

The working of fire insurance is an instance of how impossible it is to separate good from evil. According to a writer in *Lippincott's Magazine*, from twenty to thirty per cent. of fires are purposely set to gain the insurance money. The same writer says that in New Hampshire the action that drove insurance companies out of the State reduced the losses from fire by about thirty per cent. From this it may be concluded that those who deal honestly in the matter of fire insurance must pay thirty per cent. of their offerings to cover dishonesty. Add to this the salaries of officers and the profit of companies, and it must be conceded that not more than fifty per cent. in the way of returns can be had for money invested in fire insurance.

"Pure leaf lard" is now made of cotton-seed oil, not a very good quality of oil either.

Some Notes on Steel.

By John Coffin.

The first thing to be done to a piece of steel in the tool room is to anneal it. I hope I shall live to see the day when this work will be done, not in the tool room nor in the smith shop, but in the ovens of the steel manufacturer. I cannot see why it has not drifted there before, for it would cost the manufacturer not more than $\frac{1}{10}$ of a cent per pound to do it well, while the expense to the tool maker is not less than 1 cent for annealing a pound, with uncertain results. However, until some manufacturer has the good sense to make the move we will have to be content for our steel to have the beautiful blue-black, hammer finish so much admired by the hardware dealer, but so much detested by the tool maker; and we will also have to continue teaching our young men how to anneal this material.

When steel comes to the shops its crystalline structure is very favorable to easy cutting, but it is hard, because its treatment, in the process of manufacture, has placed much of its carbon in the form of hardening carbon. It follows then that, to make it very soft, we must heat it to a temperature at which its carbon can all, or nearly all, change to non-hardening carbon, and yet to one at which its crystalline structure will not be greatly changed; there is such a temperature, which is below the hardening temperature, and it can be easily attained by practice.

There are two reasons why we should not heat tool steel to the hardening temperature in annealing it: 1st. Because the carbon is thereby changed to hardening carbon, and, in cooling, the work which was partly done before has to be done over again. 2d. Because in cooling slowly from the hardening temperature a crystalline arrangement takes place, which is unfavorable to softness.

Softness, in the sense in which I shall use it, I will define as meaning the ease with which the steel is cut in the lathe or other machine tool; besides this measure of softness there are two physical tests, one of which consists in indenting a carefully prepared flat surface with a standard shaped cutter, under a standard pressure, and afterwards measuring the indentation; this is called the hardness test. I once made an apparatus for making the hardness test, by the percussion of a falling weight, the device being designed to determine the hardness of large work without cutting out special test pieces; but before you become too much interested in this machine, let me say it was a total failure, the varying spring of the work under the blow rendering the results very uncertain and the scrap heap being made larger.

The other physical test for softness is the elastic limit, in using which we must remember, the higher a piece of steel is heated in annealing, the lower the elasticity will be (within ordinary limits). The indentation hardness test seems to be a mean between the elastic limit test and the practical cutting test, but the results are somewhat erratic.

I have given two reasons for heating steel low in annealing, and I think there is a third and greater reason, though I have not made experiments enough in this direction to announce it as a fact, notwithstanding that all my observations tend to strengthen my belief. It is desirable not only to have tools made accurately, but to have them retain their accuracy after hardening, and if steel is annealed evenly at a low heat, it is more likely to be regular in its change of volume in hardening. It is very provoking to count on a $\frac{3}{4}$" tap becoming two-thousandths of an inch larger after tempering, and find it comes out one-thousandth smaller; but I will not enlarge on this point, as I will treat of the change of form by tempering in its proper place. The correct annealing temperature is a low red, though I do not know exactly what to liken it to; it might be given in the fusing points of alloys, but that would be as unintelligible as degrees Fah-

renheit, so I will simplify matters by telling you to knock the ashes from your cigar some evening as you walk along the streets, turn it up and look at it, then make your steel (in the dark) about that color, and you will not be far wrong.

The next requirement, after the correct heat is reached, is to give it all the time you can at this temperature, as it takes time for carbon to change from hardening to non-hardening.

It is known that as annealing is ordinarily done, if the steel is heated slowly it will be softer; I once thought this was directly due to the slow heating, but I now think it is because, by that means, the aggregate time of heating and cooling at which the temperature is favorable for the carbon to pass to the non-hardening form is made greater. To make steel very soft, if you have a charcoal forge at your disposal, make a good fire, put your pieces of steel in, shut off all the blast and leave it so over night; in the morning you may see how a nicely annealed piece of steel will turn.

The more common practice is to heat the steel in the forge and bury it in some non-conducting material such as ashes, sawdust, powdered charcoal, or lime. Of the last two it is hard to say which is the dirtiest, and, where a slight decarbonization of the surface is not objectionable, I prefer lime, for it is more easily obtained. Some one who reads this will smile and say, "That may be a very fine theory, but to one who has obtained his knowledge in an every-day practical sort of way, it seems a little bit absurd. Have I not tried to anneal steel in that way time and again and failed, and finally, after failure, made it soft by heating it very much hotter? How can you make your theories explain away what I know to be a fact?" Well, my friend, I will try.

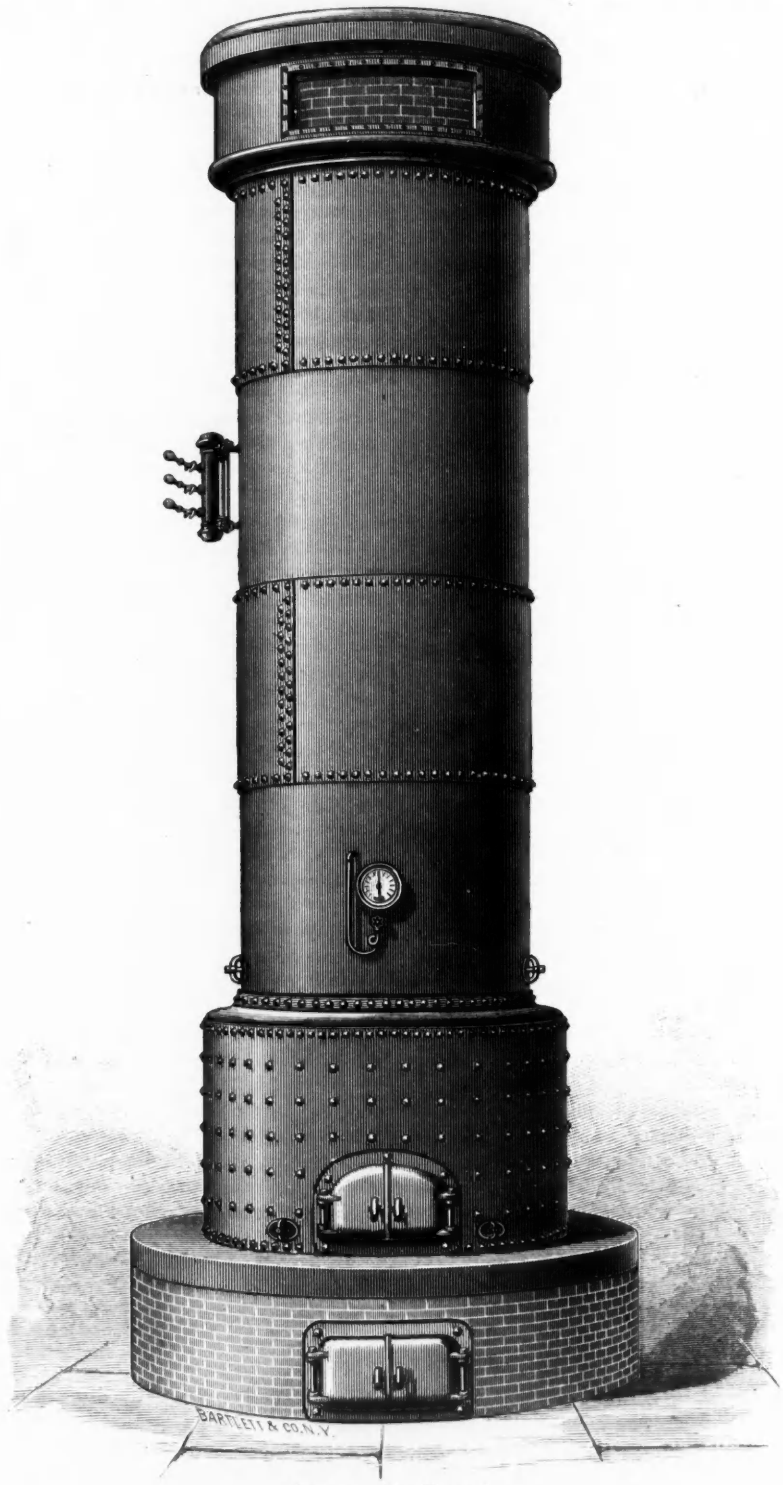
I have done that same thing myself, and do it yet sometimes as a makeshift, but it is not the best way. Was it not always a small piece with which you had this trouble? I think so, and the reason is, a small piece cools more quickly than a large one, and it takes time for hardening carbon to change to non-hardening carbon. By heating the piece hotter and putting it in the lime, it, being a non-conductor, was highly heated, while the piece was cooling down to the point at which the carbon change was possible, so that, when it arrived at this point, it was surrounded with a hot blanket of lime, and its subsequent cooling through the carbon change period was much slower. The piece was softer than it was before, because a greater amount of carbon changing to the non-hardening form more than compensated for the poorer crystalline structure.

But, after failing to get a soft piece by annealing at a low heat, did you ever get the same piece very soft by high heat? I have admitted that, if there are certain restrictions, small pieces of steel may be made softer by bringing to a higher temperature, and yet, I have said that a high annealing heat is very unfavorable to the greatest softness; how then are we to soften small pieces of high steel? The only answer I can give is: Remove the restrictions, provide means for slow cooling, or for maintaining the temperature at which the carbon can change for a longer time (remembering that softness is not due to slow cooling, but to the fact that the correct temperature is maintained for a long time), and ways will suggest themselves.

Sometimes you have one small cutting tool to make, and have not time to fire up your furnace, if you have one, and cannot afford to nurse it in the fire; you want just to heat it up in an off-hand way, and stick it in something to cool while you go about your other work. Let me suggest what I think would be a good plan in such a case, though I never tried it. Have a few long thick bushes of—say wrought—iron, perhaps 6″ long and 2½″ outside diameter, with from ¾″ to 1″ hole through the center. Suppose you have a piece to anneal, ½″ diameter and 5″ long; put one of the bushes in the fire first, and heat it up to a good heat; during the latter part of the heating put the steel in, and get an even, very low heat on it. Then put it in the bush, and bury them both together in the lime. They might be heated together, or you might find that you could get the bush hot enough for the steel to be put in cold and become heated by conduction after being covered. In any case see that the steel does not get too hot at any time.

There is a belief that if a number of pieces of hot steel are put in lime to cool, they should not be in contact with each other; for it is said that, at the point of contact, the steel is changed, so that it cannot afterwards be hardened, and the result will be soft spots in the finished tool. I have annealed a great many tons of steel in lime, and have never observed this result. I have never tried to avoid contact of pieces; on the contrary, I have always put small pieces close together, so they might keep each other warm. However, I can see how a slight decarbonization might take place at the point of contact, especially if the steel had been heated very hot; for the carbon of the steel would have more tendency to be taken up by the lime, forming carbonate of lime, if the lime lying next to it was to become highly heated; and where pieces lie very close to each other there is confined between them a thin layer of lime, which would become very hot.

I will not comment on the water anneal in this connection, for it is not a desirable tool-room practice; but, if I have time, I will show you in some future article how little I know of this wonder.



Boiler.—See Page 1.

Engineering and Mechanical Notes.

By F. F. Hemenway.

II.

HEAT.

It is only about fifty years since the present theory of heat was accepted by scientists or mechanics. Previous to that time heat was believed to be a mysterious material, something that insinuated itself into all bodies with certain observed effects. But the fact that heat was produced as the result of doing mechanical work gradually led to the understanding that the sensation called heat was simply motion or vibration of the particles or atoms—too small to be observed—of which all matter is composed; this also led to the establishment of the fact that there was a certain relation, capable of being defined, between heat and mechanical work.

According to the mechanical or dynamical theory of heat, the atoms of all bodies are in motion more or less intense, and this motion cannot be made to cease, because there is no known means of reaching a sufficiently low temperature. Conclusions arrived at by following the path indicated by certain observed facts have led scientists to believe that a temperature 461°.2 degrees below the zero of the Fahrenheit thermometer, would be that of absolute cold, and at that temperature all motion would cease. Of course there is no way of verifying this, and the reasonings by which the conclusion is arrived at are not entirely satisfactory. For example, so far as observation goes it is found that a perfect gas will contract in volume and pressure uniformly as heat is withdrawn. Taking the range of contraction between certain pressures and following it to final conclusions at the temperature named—461°.2 degrees below zero—there would be neither volume nor pressure of the gas. But as it is impossible to conceive of this—in effect—total extinction of matter, this reasoning does not appeal to finite senses. This temperature of 461°.2 below zero is called absolute zero; it is an ideal temperature, useful in some calculations in regard to heat.

EXPANSION OF SOLID BODIES BY HEAT.

As the temperature of a solid body is increased the vibration of its particles increases in intensity. This increase in intensity of vibration calls for more space, hence the bulk of the body is increased, or, as it is said, it is expanded by heat. Different bodies are differently affected by heat, some being expanded more than others by equal increase of temperature. As the temperature is increased it is also found that the expansion is not quite regular for equal intervals—as degrees—of heat. The variation in this respect is not, however, sufficient in extent to be of great importance to the man who wants to know something about the matter for practical purposes.

Engineers' pocket-books contain tables giving the expansion of various substances, but the tables are not always, nor generally, in the best form for convenient use. The following I find in a shop pocket-book, written in for everyday use. It covers most of the materials the mechanic has to do with:

Material.	Variation in Length for Each 10 Degrees Change in Temperature.	Melting Point in Degrees.
Antimony	.0000603	880
Bismuth	.0000772	512
Brass-cast	.0001041	1760
Brass-rolled	.0001054	
Copper	.0001003	2000
Iron-cast	.0000617	2100
Iron-wrought	.0000667	
Lead	.0001587	620
Steel	.0000653	2400
Tin	.0001225	450
Zinc	.0001700	780

No table, however elaborate, of the expansion of solid bodies by heat is absolutely correct; but such tables serve fairly well for all except scientific purposes.

The melting points given are nothing more than approximations, owing to lack of accurate means of measuring high temperatures.

The little fragment of a table as above, always handy in the pocket, has come useful many times. Suppose it was the case of a plain boiler, 50 feet long, at 60° temperature being set. If steam of pressure equal to 330° temperature was to be carried, the increase in temperature would be 270°, and the length would be increased 27 times that given in column 2, or $.0000667 \times 27 = .0018009$ times the length; this multiplied by 50 gives .090045 of a foot, and again by 12, 1.08—a little more than an inch that the boiler must go somewhere when hot. Similar reasoning is applicable to steam pipes, and to many other things, and will show how far it would be safe to employ different kinds of metal united together.

SHRINK FITS.

The machinist's shrink fit is one of the most familiar examples of the expansion of bodies by heat. Here the contraction of the metal around the hole leaves whatever is fitted to it almost immovably fixed. If we assume that the fit should be .0025 large (which is ample up to 6″ diameter, beyond which it may be further reduced to .002 at 12″, and still further as the size increases), we can see how hot the piece must be made. Cast-iron expands .0000617 for each 10°; then .0000617 : .0025 : : 10 is to 405°, the increase in temperature required. A liberal allowance can be made to insure the pieces going together easily, and still the piece need not be heated much more than one-half as hot as is the ordinary practice; heating so hot as is frequently done is a positive damage.

Early Engineering Reminiscences.

By George Escol Sellers.

Thirty-first Paper.

As we were leaving the Maudsley works, Mr. Brunell, of Thames tunnel fame, came in. After an introduction, I told him it was my intention to call on him, as I had a letter of introduction from his friend and brother engineer, Mr. Heartly, of Liverpool, but had not the letter with me. This resulted in an appointment at 9.30 the next morning, at the tunnel. He said if I had not been an American he should not have named so early an hour. This I took as a compliment to our countrymen.

I was promptly at the tunnel at the appointed time and found Mr. Brunell already at his office, but not by any means in a state of mind to be envied. Work on the tunnel had for a long time been suspended. The pumps were at work, but the state of the air and water prohibited going into the tunnel at that time. Mr. Brunell showed me the plans and drawings, explaining everything clearly. He had encountered unforeseen difficulties that his most careful borings and soundings had not developed. Neither had the previous drift way of 1807 and 1808.

The idea of carrying forward and completing as they advanced the full size tunnel without an advance drift, was certainly a bold and grand conception of Mr. Brunell's, and when the difficulties did occur, he had overcome them, and when all serious ones to be apprehended had by actual experience been provided for, he was shut down on, and the work suspended entirely, in consequence of financial difficulties. He said it was true that the cost so far had greatly exceeded his estimates, but this might partly be attributed to hue and cry of failure by engineers who were envious and by experts without either examination or knowledge. Every difficulty had been magnified; any increase in steepage or change in tenacity of the earth he was working through, the least softening or invasion by streaks of old river silt as they were encountered, were represented as insurmountable, and were made use of, alarming the operatives; in some cases men refusing to go on with their work. In this state of things a constant increase in cost, in the shape of advance in wages, had to be encountered. Mr. Brunell was suffering as bold pioneers in great enterprises too often do; but it was evident he had not lost confidence in himself or in the wisdom of the plans he had adopted, or in ultimate success, whatever the capitalists, the bone and sinew of the enterprise, may have done. Young as I was, he seemed anxious, and took much pains to impress me favorably as to his plans and ultimate success of the enterprise. He made light of the difficulties, and in no manner boasted of his achievements in overcoming them. But he laid great stress on the great additional cost due to the suspension of the work, for had all that had been and was being expended on the maintainance of the work in its unfinished condition by continuous pumping, and other unavoidable outlays, been applied to the direct prosecution of the work, it would have been in a condition to disarm all skeptics. He was quite complimentary to America when he said he did not believe such a state of affairs could be brought about in that go-ahead country. He based his hopes of completing the work on the large sums of money that had been expended, that, if abandoned, would be a total loss, and that, rather than that, he believed the amount required to complete would ultimately be raised, as the estimated cost was then based on actual experience. Nearly half the distance had been accomplished and at the time the work was suspended the center of the river had been reached. The time of my interview was about seven years after the commencement of the work. This fact alone is evidence of its great magnitude and the constant strain on Mr. Brunell's brain. It is not my intention to describe the work, for that has been fully done and must be familiar to most engineers. But I was much interested in the model of the great sectional shield, and in Mr. Brunell's description of the manner it was used to make the excavation of 38 feet in width by 26 feet 6 inches high under the bed of the river, in which excavation was built as the work progressed, the great double brick archways, or arcades as they were called in England.

Mr. Brunell gave figures of the cost of the work up to the time of suspension, which, on reducing to our currency, showed the cost to have been about $35 for every cubic yard of earth removed—this included work done, brick arches, etc. I give this entirely from recollection; the amount was so strongly impressed on my mind at the time, that I am satisfied it is correct as we then figured it. After this Mr. Brunell again referred to his statement of the accumulated expenses during the suspension, showing from them what would have been accomplished had they been applied on progressive work.

It was about midday when I left Mr. Brunell. I went up the Thames to Old Wapping Stairs, the nearest ferry crossing to Donkin's Bermondsey shops.

I was so fortunate as to find Mr. Donkin in his office; I presented my letters as I had been advised to do by Mr. Swan. He opened the first one, glanced over it, and laid it open on his desk, and opened the second, treating it in the same manner. I could read nothing from his calm, impassive face, but on opening the third there was an evident change of expression; he read it very slowly, seemingly in deep thought. Before opening the letters he had asked me to be seated. Still holding the last letter in his hand he turned to me saying, "This letter is from a most worthy gentleman whose requests I am always glad to respond to. I had a letter from him a day or two ago in which he mentioned having given you a letter, and I have been expecting you to call on me. In this letter of introduction he states that you are engaged in the paper machinery branch of my business in America. You have seen in operation at his mills one of my latest and most improved machines; after they have left my shop I have no further control of them, and their owners are at perfect liberty to show them to whomever they please. I have in my erecting shop the widest and finest machine I have ever built to fill an order from France, which I will take pleasure in showing you. But the tools and various machines and appliances I employ in their construction have been the work of almost a lifetime, and I hope you won't take amiss my unwillingness to exhibit them." He then added: "I am glad you have not come under false colors, as I am sorry to say mechanics have done." This was plain talk, and I felt that it ended my hope of seeing his works. As he got up to lead the way to the erecting shop, I mentioned to him that I had brought to England a paper pulp dresser or screen, invented and patented by my father in the United States, with the intention of patenting it in England, if, on investigation, I found it would be worth the expense of doing so, and as to the cost I had obtained all the information I required from Newton & Son. But having seen at work on two of his machines the Ibbotson grate bar screen working satisfactorily, I was in doubt what course to pursue; that if not patented, and left free to any one, it might seriously interfere with the Ibbotson patent, and as he was the maker of that, and knew all about their cost, I would be glad to have him examine my father's, and if willing to do so to give his candid opinion of their respective and comparative merits. To this he replied by asking if I was aware of the danger of showing the machine to any one before either caveating or patenting, that in case of litigation the testimony of any one having seen it would vacate the patent; he would advise my entering a caveat before showing it to any one. He seemed pleased when I said he was the only person I had thought of, believing that in showing it to, and consulting him, I ran no risk, and that I should highly value his opinion, and that if he did not object I would have the box in which it was packed forwarded to him. He made no reply, and we went into the erecting shop where stood, certainly, the finest specimen of workmanship that I had seen in England. It was the long web or Fourdrinier machine, 60″ in width between the deckels. The machine stood as it was to be placed in the mill, with shafting and gearing all complete. Great care had been taken that in no place the wet paper should come in contact with iron, under the mistaken idea that such contact produced the rust spots so common at that time in English printing paper. The paper makers did not appear to have discovered that such spots were mainly due to want of thoroughly cleaning the rags, that broken needles, iron button eyes and such like things, after being ground up in the beating engines, passed into the paper and oxidized there; that the remedy that I have before referred to was sand traps in the beating engines, believing them to have been of American origin, had not been generally adopted in England, that the freedom from such spots in the high grades of the hand-made paper of the Whatman's and other mills doing that character of work, was almost entirely due to the care in selecting and cleaning the rags. To return to the machine as it stood in the erecting shop, the press rolls were composition metal, in color that of gun metal or bronze. When I spoke to Mr. Donkin of their composition he made no reply. It was evidently one of his secrets. The web and felt-carrying rolls were also of composition metal, but in color nearer that of brass. The drying cylinders were cast-iron covered with copper. These were splendid specimens of workmanship. The bosses on the main driving shafts were turned, the eyes of the wheels bored and keyed on them; in fact, all gearing was either secured by set screws or was keyed on round shafts. Here was the first conclusive evidence of evolution in the right direction that I had seen. The mind of the great inventor who had perfected that wonderful machine for the continuous sheet of unbroken paper, had also been turned to simplifying its construction, and making all parts interchangeable.

After viewing the machine, in which I was not in any way limited in time, for Mr. Donkin seemed to take pleasure in exhibiting it, he led the way back to the office. Of course, I, for the time, abandoned all hopes of being shown through the shops. When about leaving, he referred to the pulp dresser, and said he must again caution me showing it to any one. To this I replied by repeating what Sir Walter Scott had said to my uncle, Rembrandt Peale, as to his friend, "Honest Bryan Donkin, the machinist," that with such an endorsement I felt that I ran no risk, and should send the pulp dresser to him.

His face brightened with a look of great satisfaction, as he said "that when Sir Walter acknowledged the authorship of the Waverly Novels, and said that for a long time it had been known to twenty people, none of whom had abused his confidence, he was proud of knowing that he was one of the twenty; he then added, the acquaintance, and, he might say, intimacy with Sir Walter had come about in a most natural way; he had frequent consultations with the Constables, the publishers of Scott's novels, on the subject of paper for that purpose, at which Sir Walter was often present."

He said that Mr. Swan, in his letter to him, had expressed a belief that it would be mutually advantageous to us to have a free interchange of ideas on paper machinery, and he laughingly added: "My ideas have gone to America in a machine I sent there to fill an order, and I learn they have already been copied." I told him that so far we had been exclusively engaged on cylinder machines, and had never built a Fourdrinier; that at that time Phelps & Spofford were the only builders in the United States. He asked what we got for a complete squirrel cage cylinder, naming a size. On my giving our regular price, he promptly said that he could not compete, pay freight and duty, for our price was less than he got at his works. This I felt to be my opportunity, so I explained our mode of putting up the cylinders, the machinery and tools we used. He listened very attentively, but made no comments. I could not but admire his extreme caution and reticence as to his modes. At the same time his evident eagerness to learn what others were doing amused me, and I felt much like a man in the hands of an interviewer of the present day. But to divert, and at the same time lead him on, I remarked that I had been surprised at not finding the direct-acting guillotine paper cutter in use in England, when in America they had almost entirely superseded the plane or bookbinder's trimmer for all paper trimmed and put up at the mills. He understood there were very serious objections to them, inasmuch as a chisel-edged knife could not be thrust directly down through paper, without turning or making a sharp edge on the lower side of every sheet. Yes, I replied, if the paper is loose, but the pile of paper to be trimmed being pressed lightly together, the knife goes through it like shaving wood, and added, this you can try with a sharp chisel, when you have the paper pressed on a calender roll shaft, ready for the lathe. He had never thought of this, but should certainly try it. He then asked if I would, for a consideration, sketch the most approved plan in use. I replied that I would cheerfully and freely give him any information he wanted; the machine was patented in the United States, and at that time we were the exclusive builders, paying the patentee a royalty on each machine; that their introduction had been rapid; that in the United States there were very few mills without them; that printers and bookbinders had generally adopted them for pamphlet trimming. It was growing towards night, and as I had an engagement for the evening, and, moreover, began to feel hungry, I again essayed to go, when Mr. Donkin asked if I had ever given a thought to the possibility of making an absolutely perfect screw. Mr. Saxton had told me this had been a hobby with Mr. Donkin for many years, and on the previous Sunday I had gone with Saxton to the Royal Observatory at Greenwich, where we had seen the great mural wheel that had been turned at Donkin's works, and graduated by Throughton with one of Donkin's screws. I replied that when a boy I had been much interested by my grandfather's ideas and efforts in that direction; that to generate a screw of a certain pitch, instead of setting a sharp knife edge at an angle of the axis of the spindle to be cut, as I had been shown the day previous as Maudsley's design, my grandfather had drawn hard iron wire by light drafts to insure accuracy; that this he had wound like a spiral spring on an accurately-turned iron mandrel, with a fixed collar at one end and a loose one at the other, driven up by a screw nut, to force and hold the coils when wound in close contact. On this he had cast a fusible metal nut. I had found this in grandfather's shop with a number of wooden rods wound in the same manner with wires of various sizes; these latter he had explained as having been used in testing and correcting his wire gauge by the numbers of coils to the inch. The iron one, he said, was an effort to produce an accurate screw for his friend, David Rittenhouse. He did not say for what use, but I infer it had something to do with Rittenhouse's astronomical work. I hastily described old John White's expedient for cutting press screws before the time of engine lathes that I described in my second paper. Mr. Donkin had evidently got on his hobby; he insisted on my stopping to see a couple of his screws for graduating. They were of steel, about $1\frac{1}{4}$″ diameter and about $1\frac{3}{4}$″ long, as near as I can recollect; one of 25, the other of 50 threads to the inch. This was firmly placed over the 25-thread one, so that 50 threads calipered them. In front a movable microscope, with a finely-gradu-

ated micrometer eyepiece; by sliding the microscope and turning the screws, the least possible variation could be detected. It was growing too dark to see this to advantage. Mr. Donkin spoke enthusiastically as to what Mr. Maudsley had done towards establishing standard screws; but as to absolutely correct ones, he said: "We may have a screw with a deep or long nut on it, that works smooth and easy, and with the most delicate handling no imperfection can be discovered, yet, on using the screw for a dividing engine, errors would soon be apparent."

He asked if I had ever thought of or seen any device for testing irregularities or gain or loss of one thread over another? None but a very simple one of Isaiah Lukins, town clock maker of Philadelphia—a little sliding carriage parallel with the screw to be tested. This carriage had a fixed point in the groove or channel of the screw. By turning the screw it would be made to advance in either direction as the screw was turned. In this carriage in the plane of the axis of the screw was an adjustable stud or center that could be set at any number of threads desired from the carrying point. On this stud was a lever or index hand, as Lukins called it, the short end fitting into a channel of the screw, the long end resting on a graduated arc, adjusting the fulcrum stud so that the index hand pointed to O. On turning the screw to advance the carriage by the fixed point, the least variation would be shown by the point of the index lever. There was also an arrangement to measure short inequalities by using the obliquity of the thread by either raising or depressing the lever on the center pin or fulcrum. I did not know what mode had been taken to correct errors when found, but I thought Mr. Saxton, who had served his apprenticeship with Lukins, would be able to give all information. He had never spoken to Saxton on the subject, but he should certainly take the first opportunity of doing so. He did not then say what he had done, but only remarked that it was wonderful that minds over 3,000 miles apart should in any degree travel the same roads. He threw the covers off of some of his apparatus, no doubt with the intention of showing and explaining. But the increasing darkness, and my evening engagement, forced me to tear myself away. The shops were far out on the Blue Anchor road, some three or four miles from where I was stopping. I might be obliged to walk a long distance before I could catch a cab or omnibus. On leaving, Mr. Donkin presented me with a one-foot boxwood scale of his own graduating, which I have had in almost constant use to the present time, and value it highly.

I found Mr. Saxton waiting for me for our evening engagement, but not having had a mouthful since an early breakfast, food must first be discussed. When I told him what an enjoyable afternoon I had with the great inventor, he asked: "Did he show you through his shops?" "Only his erecting shop." Then came: "I told you so; they are closed against all foreigners, particularly Americans." "But," said I, "the end has not come. To-morrow I am to send him the pulp dresser. He took my address and promised that after seeing it I should hear from him." "No doubt," said Saxton, "and that will be the end of it." To which I could only reply by using Jacob Perkins' favorite axiom: "We shall see; time proves all things."

The various engineering papers continue pounding away at that "mysterious dispensation of Providence," the boiler explosion, and they are doing good work in impressing upon steam users the fact that the surest way to invite one of these mysterious (?) accidents is to employ incompetent, careless and underpaid engineers.—*The Milling Engineer.*

Yes, and "the various engineering papers" will continue to pound away until eventually some good will come of the "pounding." Our milling contemporary can, if it will, help in the matter.

The proposition in the House of Lords, in Britain, to the effect that chimneys may be prohibited from emitting smoke, is a reminder of the monarch who set his prohibition on the inflowing tide. Chimneys will smoke, in spite of even the House of Lords. It's too bad, but it's true.

A Rap at Corrugated Boiler Furnaces.

Mr. Walter Swanson recently read a paper before the London Association of Foremen Engineers and Draftsmen, in which he took rather decided grounds against corrugated furnaces. These furnaces, he thought, might possess advantages when new and clean; but these advantages soon disappeared with use, the corrugated furnace soon becoming less efficient than the plain furnace.

The writer favored triple expansion engines. He did not favor india-rubber valves for air pumps, noting the fact that they were liable to crack and to failure. He preferred the use of metal valves.

Modern Locomotive Construction.

By J. G. A. Meyer.

THIRTY-SEVENTH PAPER.

PRACTICAL EXAMPLE OF SETTING THE VALVE GEAR OF A LOCOMOTIVE IN THE ERECTING SHOP.

Example 42.—Throw of the eccentric is 5 inches; lap, $\frac{15}{16}$ of an inch; lead, $\frac{1}{16}$ of an inch; clearance between piston and each cylinder head is to be $\frac{3}{8}$ of an inch; type of locomotive is one in which the eccentrics are placed on the main axle, that is, the axle to which the main rod is connected; it is required to set or adjust the valve gear. In this example the position of the saddle pin on the saddle is assumed to be correct, so that in setting the valve gear no loose saddle is to be used.

To the young mechanic it may appear that setting the valve gear of a locomotive is a very mysterious and difficult operation. Yet, if he understands the theory of the valve motion, which we have endeavored to explain and make plain in our previous papers, and takes hold of setting the valve gear in the erecting shop in a systematical manner, this operation will lose all its mystery, and will not be such a difficult problem as it first appeared to be. True, in attempting to set the valve gear, we are confronted with that which may seem to be a very mixed up problem, because the correct position of the eccentrics on the axle, and the exact length of the eccentric rods must be determined; and since these two items are intimately connected, it may often be asked, which of the two has been correctly found? But by dividing this problem into a number of simpler ones, the writer believes that this operation of setting the valve gear, or the solution of this practical problem, will be comparatively easy. In connection with the setting of the valve gear a few preliminary preparations are necessary; this whole subject will be treated in the following order:

1st. Blocking up the main axle boxes in the pedestals of the frames.

2d. To find the exact position of the crank-pin when the piston is at the beginning of a stroke.

3d. To test the amount of clearance between the piston and cylinder heads.

4th. To connect the eccentric rods correctly to the link.

5th. To find the correct length of the eccentric rods.

6th. To find the correct position of the eccentrics on the axle.

7th. To lay off the notches in the reverse arcs.

In this example it is assumed that the reverse arcs are properly fastened in their position; and that these arcs have no notches. Also that the reverse lever and lifting shaft are in correct positions; and that the reach rod connects the reverse lever and lifting shaft, and lastly, that the links are suspended from the lifting shaft arms; and that the former are properly attached to the lower rocker arms; and also, that the connections between the upper rocker arms and the valves are complete.

1. BLOCKING UP THE MAIN AXLE BOXES IN THE PEDESTALS OF THE FRAMES.

The locomotives should rest securely on blocks so that the main driving wheels can be lifted off the track and held in this position, which will allow the main driving wheels to be easily turned around in their boxes. In lifting the main driving wheels off the track, they should be raised to a position in the pedestal which corresponds to the position of these boxes in the frame when the engine is hauling a train.

The general practice is to give $1\frac{1}{2}$ inch clearance between the axle box and pedestal cap; and about 3 inches clearance between the top of axle box and frame. In smaller engines whose axle boxes have less clearance in the pedestals, the proportion between the upper and lower clearances should be about the same as that just given; namely, the clearance on top of the axle box should be about twice as great as that below the box. If then $1\frac{1}{2}$ inch is to be the clearance at the bottom, blocks each $1\frac{1}{2}$ inch thick are inserted between the main axle boxes and the pedestal caps, which will hold the main driving wheels off the track and in the correct position during the time the valve motion is to be adjusted. No attention need to be paid to the other boxes and wheels, since in this class of engines it is not necessary to put on the side rods for the purpose of setting the valve gear; in fact, the side rods would be in the way, and would give unnecessary labor in revolving the main driving wheels.

2. TO FIND THE EXACT POSITION OF THE CRANK WHEN THE PISTON IS AT THE BEGINNING OF A STROKE; OR, IN OTHER WORDS, TO LOCATE THE DEAD CENTERS OF THE CRANK.

Fig. 201. The following remarks refer only to the setting of the valve gear on the right hand side of the engine. The manner of setting the valve gear on the left hand side of the engine is precisely the same as that adopted for the right hand side. First set or adjust one side, and then the other

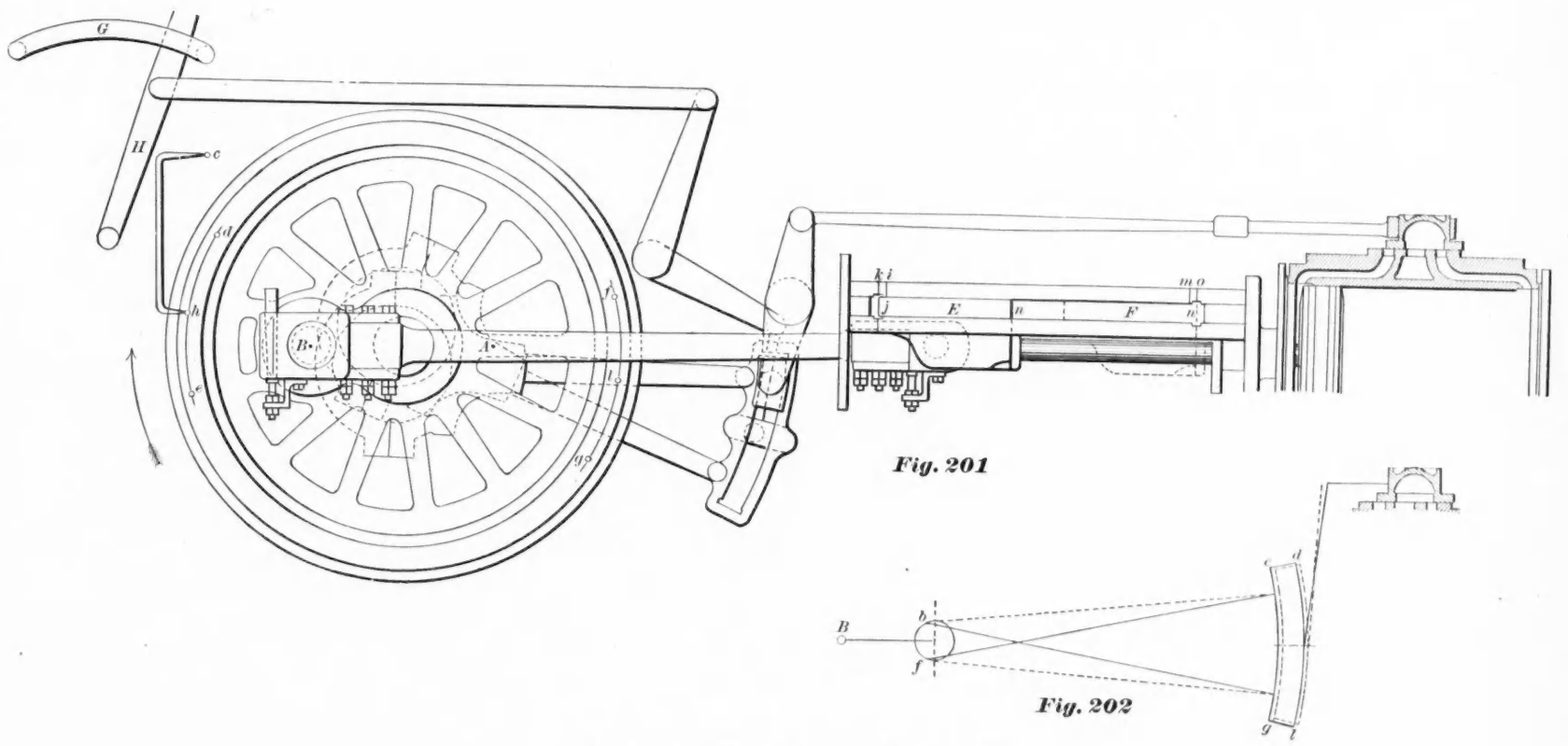


Fig. 201

Fig. 202

SETTING THE VALVE GEAR OF A LOCOMOTIVE.

side. On the face of the tire describe with the aid of a gauge two arcs *d e* and *f g* in about the same relative positions to that of the crank as shown in the figure; care should be taken to describe these arcs as true as if they had been described in the lathe. Attach the main rod to the crank-pin and crosshead; but at present do not fasten the piston-rod to the crosshead. Now turn the driving wheel in the direction of the arrow, until the crosshead is within a short distance from the end of the stroke, say ½ of an inch; while in this position mark on the slides a line *i* even with the end *j* of the crosshead. Also while the wheel and crosshead are in this position, place a center punch mark *c* on the side of the fire-box or any other convenient fixed piece of mechanism. From this point *c* as a center and with a tram of any convenient length as a radius, describe on the face of the tire a short arc, cutting the arc *d e* (previously marked on the tire) at the point *d* (this point *d* will at this instant lie under the end *h* of the tram, and not as shown in the figure). Now turn the wheel in the same direction as before, causing the crosshead to complete its full stroke and a very small portion of its return stroke, and when during this motion the edge *j* of the crosshead touches the line on the slides, stop turning the shaft, and while in this position describe from the center punch mark *c* as a center and with the same tram as before, a short arc on the face of the tire, cutting the arc *d e* at the point *e*. Midway between the points *d* and *e* on the arc *d e* lay off a point *h*. Turning the wheel in a position in which the tram will touch the points *c* and *h*, the crank-pin will then be at *B*, and the piston at the beginning of its back stroke; or in other words, the crank will then be on one of its dead centers. While the crank stands at *B* draw on the slides a line *k* even with the end *j* of the crosshead; this line *k* will indicate the end of the stroke, that is the end *j* of the crosshead will not travel beyond the line *k* with the connecting rod attached. In order to locate the other dead center *A* we again turn the wheel in the direction of the arrow until the crosshead is within a short distance of the front end of the stroke, say ½ of an inch, and while in this position mark on the slides a line *m* even with the end *n* of the crosshead; also before the wheel and crosshead are moved out of this position, describe on the face of the tire, from the point *c* as a center and with the same tram as used before, a short arc cutting the arc *f g* at the point *g*. Next, turn the wheel in the same direction as before, causing the crosshead to complete its return stroke and a small portion of its forward stroke, and when the edge *n* of the crosshead again touches the line *m* on the slides, stop turning the wheel. From the center *c* and with the same tram describe on the face of the tire a short arc cutting the arc *f g* at the point *f*. Mark off the point *l* on the arc *f g* midway between the points *f* and *g*. Now, turning the wheel in a position in which the tram will touch the points *c* and *l*, the center of the crank-pin will be at *A*, which is the other dead center. While the crank-pin is at *A* draw on the slides a line *o* even with the end *n* of the crosshead; this line *o* will indicate the other end of the stroke.

3. TO TEST THE AMOUNT OF CLEARANCE BETWEEN THE PISTON AND CYLINDER HEADS.

For this purpose we must take off the main rod, fasten the piston to the piston-rod, key the piston-rod to the crosshead, and bolt the cylinder heads to the cylinder. Our example calls for ⅜ of an inch clearance between piston and cylinder heat at each end of the cylinder. Consequently the crosshead with piston-rod and piston must be pulled out as far as can be done; if then the edge *j* of the crosshead overlaps the line *k* ⅜ of an inch, the clearance is correct; if the edge *j* of the crosshead only reaches ¼ of an inch beyond the line *k*, then the clearance is ⅛ of an inch too little; or if the edge *j* of the crosshead does not reach the line *k*, then there is no clearance, and the cylinder heads are liable to burst out in attempting to turn the crank over the dead centers. In a similar manner we find the amount of clearance at the front end of the cylinder; that is, we push the crosshead towards the front as far as it will go, then if the edge *n* of the crosshead moves ⅜ of an inch beyond the line *o*, the clearance is correct; if less, the clearance is insufficient. If the clearance is insufficient at the back end of the cylinder, then a corresponding amount must be turned off the back cylinder head. An insufficient clearance at the front end may be caused by the heads of the follower bolts projecting too far beyond the piston; in that case a groove must be turned in the front cylinder heads, which will clear the heads of the follower bolts; or the insufficient clearance may be caused by the front cylinder head projecting too far into the cylinder; in this case a sufficient amount must be turned off the front cylinder head. In some cases an insufficient clearance may be caused by the piston being fitted out of square on the piston-rod; in that case the faces of the piston must be turned off. The writer in his experience has never found the clearance to be too great, but has often found it to be too little, generally owing to the roughness of the faces of the piston and inside surface of the cylinder heads, as these are seldom turned unless absolutely necessary to give the correct amount of clearance.

4. TO CONNECT THE ECCENTRIC RODS CORRECTLY TO THE LINK.

In locomotives it is necessary to preserve the lead, no matter in what position the link may be placed. In the twenty-ninth paper we have shown that the eccentric rods can be connected to the link in a manner which will increase the lead as the link is moved from full gear to midgear. In the same paper it is also shown that the eccentric rods can be connected to the link in a manner which will give lap instead of lead when the link is in midgear. Now, since we must have lead in whatever position the link may be placed, it follows that the eccentric rods must be connected to the link in a manner which will accomplish the desired result. In Fig. 201 the piston is at the beginning of its backward stroke, and the eccentric rods are shown to cross each other, and, consequently, when the axle has made one-half of a revolution, and the piston is at the beginning of the forward stroke, the eccentric rods will not cross each other, as shown in Fig. 29 (tenth paper). This manner of connecting the eccentric rods to the link is correct, because it will give lead, no matter in what position the link is placed, although in midgear the lead will be greater than in full gear (see twenty-ninth paper). The reason why the manner of connecting the eccentric rods to the link should affect the lead is clearly shown in Fig. 202. In this figure the different parts of the valve gear are represented by center lines; the arc *d l* represents an arc drawn through the center of the link opening, and the arc *e g* represents the arc in which the centers of eccentric rod pins are located. The full lines show the correct manner of connecting the eccentric rods to the link, and the dotted lines represent the incorrect manner of connecting the eccentric rods to the link. Here it will be seen that by connecting the eccentric rods, as shown by the full lines, we have lead when the link is placed in midgear; and by changing the connections, as shown in dotted lines, we push the lower rocker-arm pin away from the axle, which causes the upper rocker-arm pin to pull the valve towards the axle, and thus close the port and destroy the lead when the link is in midgear. In connecting the eccentric rods to the link, as shown in Fig. 201, we must not forget that a rocker is employed. If a rocker had not been interposed, then the eccentric rods would not cross each other when the piston is at the beginning of the back stroke, but would be open, as shown in Fig. 168 (twenty-ninth paper).

The *Marine Journal* says:

Since the Alva has been in commission enough friction has occurred on board and been made public through the press to warrant the statement that the management of Mr. Vanderbilt's valuable vessel has been conducted on a scale not in keeping with that gentleman's natural liberality or disposition.

The general opinion now prevails that Mr. Vanderbilt would not have gone abroad for his model and designs, much less for the important internal fittings of his yacht, had he not been importuned to do so by *quasi* American experts.

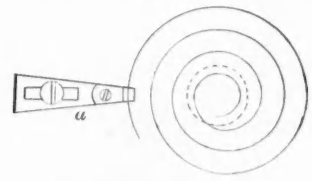
To all the above we unqualifiedly subscribe.

LETTERS FROM PRACTICAL MEN.

"Unhandy Machinery."

Editor American Machinist:

In American Machinist of March 26, Mr. Hill presents a few hints under the head of "Unhandy Locomotives," which designers and makers of machinery of every kind would do well to heed. Probably there is not a machine running to-day, from a watch to a locomotive or steamship, that is not susceptible of some improvement—some slight change in some one or more of its details which would render the machine a little handier to operate, adjust, keep clean or repair. There are none more capable of suggesting little changes of this kind than those whose daily business is to operate and care for machinery. Ask that intelligent machinist who is operating a most improved modern lathe or planer how he likes his machine, and he will probably say that it is a most excellent machine as a whole; at the same time he will suggest some little change in the position or form of some handle or detail which would be a real improvement. If I were to get up a set of patterns for any special class of machinery I would first go about among intelligent operators in that line and collect their various suggestions and ideas, and then proceed to make my



Hair Spring.

drawings and patterns. In this way I think I could start a little ahead of my brethren in the same line of business. I recently saw one of the most satisfactory pieces of fine machinery in the form of a gentleman's watch. It was gotten up for a present. The hinges of the case were not visible when the case was closed, its fitting was so perfect that the point of contact between berrel and back was scarcely visible to the naked eye. There was not a stroke of engraving or superfluity either on case or movement, except a number and name on the inside in plain fine characters. Every part of case and movement shone like a mirror. Said the dealer, this is one of the most perfect samples of watch that ever passed through our hands, but I have one or two suggestions which will apply to all stem-winders and setters. The winding and setting devices should be entirely distinct; there should be a separate crown for each, and no pulling out or pushing in to throw the wheels in and out of gear, but simply a rotary movement to do the winding and setting. Three-fourths of these nice watches that are sold go into the hands of those who are not fit to care for such delicate machinery. In winding their watches the hand that holds the watch will often do more of the winding than the hand that holds the crown—then perhaps they will leave the crown out with the setting wheels in gear." Here is another suggestion about the hair spring. It is a delicate matter to pin in a hair spring so that it will rest exactly in its normal position. The enlarged sketches will illustrate. A hair spring is shown nicely coiled ready for the watch; instead of fixing it in the usual way I would clamp the inner coil between a collar and washer on the balance staff as indicated by dotted lines and then clamp the outer end of the spring in the end of an adjustable holder, *A*, as shown; the screw hole in the holder being slotted so as to admit of its accommodating itself exactly to the normal position of the hair spring. Main springs should be much longer, if possible, than they are at present in most watches.

It seems to be impossible for some finishers of machinery to train their ideas to simple utility and efficiency. They must engraft on some useless quirks and beadings which serve only to catch oil and dust and annoy the tidy operator. Look at the present fire engines and apparatus at work covered with smoke, soot, dust, oil and sparks, with their thousand and one senseless elaborations. It is enough to disgust any sensible person, especially machinists.

F. G. Woodward.

Upsetting Steel.

Editor American Machinist:

About upsetting cold chisels and dire effects which might follow, and the parallel drawn between upsetting the fibers in steel, and the individual straws in a bundle. What ground could there possibly have been for the letter which so warmly discusses the matter? Nobody upsets cold chisels. There is not the slightest call for it. In forging the chisel from the bar there is work enough found in drawing it down sufficiently thin, and in redressing a chisel the same demand exists as in the first instance. There is no more call for upsetting than before. The chisel has become too thick by use, or by being broken off. It will be drawn out to suitable thin edge. No upsetting indicated, and none attempted.

About the straight, clean straw. There is not the slightest analogy between upsetting steel, and attempting to upset straw. Steel can be upset without the slightest injury, if it is sound, and the upsetting is judiciously done. "Straws break and become limber, and this applies equally well to steel," says the writer, who fears that chisels will be upset, and the "fiber" broken.

If, in upsetting, a piece of steel should become full of open seams, extending longitudinally, there would be no ground for charging the defects to upsetting. Upsetting only makes apparent what existed as defects in the steel before the upsetting took place. Some of the best of dies, cutters, and other tools are made by upsetting steel which is much too small.

Suppose a blank to be wanted 12″ square, or 12″ round, by 1″ thick, and no steel on hand from which to make it but 6″ square, or 6″ round steel. The man who sees no harm in upsetting will cut from the bar pieces 4″ in length, with addition sufficient to cover the loss of weight from working, and by upsetting, judiciously tempering the force of blows to the work to be done, changing occasionally to transverse working as the upsetting blows drive the metal out of the desired shape, he will make in this way, if the steel is sound, the very perfection of blanks, with every part thoroughly worked—not always the case in bar steel—and his working will have proven the soundness. Good sound steel can no more be compared to the bundle of straw made up of its individual straws, each in turn made up of longitudinal fiber, than can light be compared with darkness. A piece of stee' which will not stand upsetting in the hands of an intelligent steel worker, by judicious treatment, would either prove a failure, or at best, only indifferently good, without the upsetting. "Steel must not be upset," would be a rule impossible for the steel worker to obey, and there is no reason why the alarm should be sounded without a protest.

S. W. Goodyear.

Casting Water Fire-Backs.

Editor American Machinist:

The casting of water fire-backs for bolt heading machines is a job that gives moulders a great deal of trouble from blowing or becoming unsound. To overcome this trouble I have tried making them different ways. The most successful I have found is to get some small pieces of gas pipe, say ¾ inch pipe, and cut them off 6 inches long and put 3 inches of them in the core and

ram them up, two at each end of the core, opposite each other, and have holes made in the core-box, and ram up two half-inch rods in the core, the rods running through the whole length of the core and through the ends of the gas pipe. Then take some straw and cut in small pieces and put around the half-inch rods, ram up the core and draw out the half-inch rods and dry the core with the gas pipe in. Have prints put on the end of the fire-back pattern for the gas pipe to rest in, and when you have put your chaplets in the mould then set the core, take a make-up stick and build up the sand over the gas pipe, and take off your vent through the gas pipe up through the cope of the flask.

We make some here in this way and hardly ever have one blow. We make them as large as 6 feet long by 15 inches; weight about 500 pounds.

Before setting the core take some gum shellac and paint the ends of the gas pipe, and then dust on some dry moulding sand on the shellac, and you will have no trouble getting the gas pipe out of the casting. The shellac and dry sand will keep the iron from chilling around the gas pipe—as the same holes can be used to connect the water pipes to the fire-back when it is put in its place in the forge. David Spence.

An Engineer and Shopman's Views on the Crank-Pin Question.

Editor American Machinist:

My experience with crank-pins leads me to believe that there are but very few wheels that are quartered with any degree of accuracy. I have put them in with counter-bored wheels and without counter bore, and either way works well where the wheels are quartered correctly. Some shops have quartering machines and others have none. Those shops that have quartering machines are apt to make a mistake as well as those that quarter their wheels with spirit level and straight edges, and then bore pin holes as laid out with dividers.

I don't take any stock in the elasticity of pins, with or without holes in them. If those interested will put a marker on a pair of driving wheels when the tire is being turned they will discover that the wheels will vibrate three-eighths of an inch, when a heavy cut is taken on one tire and the other running without any cut. It will take but a few minutes to test a pair of wheels while under the engine with rods up. If you attempt to prove that the pins are right because it trams all right, you will "get left" every time. I have known pins to be out $\frac{3}{32}$" and tram all right.

High Private.

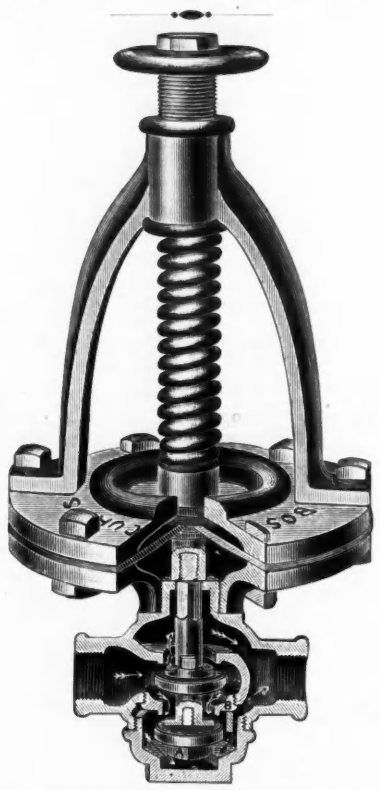
Boiler Explosions.

Editor American Machinist:

Fatal and disastrous boiler explosions are a matter of daily record, and low water, resulting from defects in the feeding devices, leakage, failure of the supply, and neglect, are conceded by all authority to be the most frequent cause. In the conspicuous absence of all other reasonable conclusions as to the cause of the many explosions which are denominated "mysterious," there is room for the suspicion, at least, that it is the cause of more explosions than it is credited with. We believe in giving the devil his dues.

In a manufacturing establishment in a neighboring city, a few months ago, the cable of a freight elevator parted with no other load than that of one man upon it, and falling to the basement, he received fatal injuries. This elevator was considered safe with a load of three tons, but it gave way with less than two hundred pounds weight upon it. Some time in the past it had been strained and weakened, and thus made ready for an accident which was as unexpected as it was fatal. So with boilers. The water may not be low at the time of the explosion but having been low at some time—probably unbeknown to the owner—the iron was crystallized, and, constantly deteriorating in daily use, finally gives way probably with plenty of water in the boiler, and perhaps under ordinary pressure.

As low water in steam boilers is always more or less detrimental, it behooves all steam users to guard against it, and anything which promises to obviate it will be of interest. C. R. S.



The Curtis Water-Pressure Regulator.

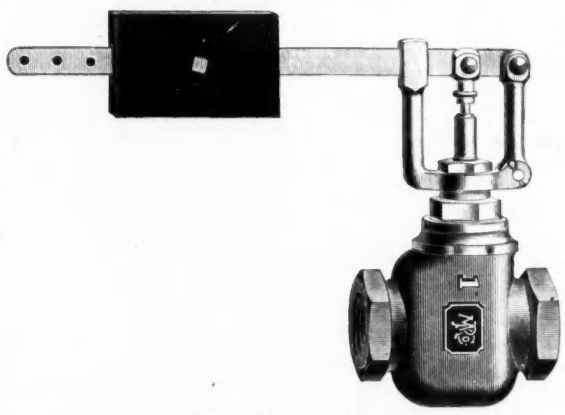
This regulator is guaranteed to deliver water into service-pipes at any desired pressure, and, however the outside pressure may fluctuate, will deliver uniformly and permanently at the point at which it is set.

The cost of plumbing can be largely reduced whenever the outside pressure is greater than is required for a free and sufficient delivery within, because lighter pipes, in connection with this regulator, can be safely used, thereby effecting a saving of from one-third to one-half in the expense for water-fittings.

The regulator can be applied within one hour from the time water is shut off, and may be so attached that the full outside pressure is available at the sill-cock for the hose pipe. The maintenance of a uniform pressure is extremely desirable in water closet plumbing, because an unusual or sudden increase of pressure will force open the closet valves, and frequently cause an overflow. Pressure reduced to the point found to be sufficient for domestic purposes prevents flying and spattering, and consequent waste of water; makes it practicable to use a light copper bath boiler without a tank; obviates the wear and tear by water hammer or concussion in pipes, and thereby greatly reduces the cost of keeping the plumbing in order.

Where houses have been plumbed with pipes of light weight for a low-pressure supply, it is often found necessary to procure water from a new source, which gives a pressure in the mains too great for the service-pipe already in use; in these cases, instead of re-plumbing the house with heavier pipe, or resorting to the use of a tank, the old pipes and fittings, with the aid of this pressure-regulator, may be retained with perfect safety, and kept in permanent use.

These regulators are made by the Curtis Regulator Company, Boston, Mass.



The Mason Lever Valve.

The Mason Lever Valve.

The accompanying cut represents the "Mason lever valve." It is a double piston balanced valve fitted with a yoke and lever with weight attached. In the stem are cut several grooves for water packing, thus doing away with the friction incident to ordinary packing. There is no lost motion in any of the joints, in order that the valve may be useful for very close regulation.

The lever valve will be found useful in controlling the supply of water in tanks by attaching to a ball float. It can also be used to control steam pumps in tank service, by placing the valve in the steam supply pipe to the pump and connecting the lever with a ball float placed in the tank. The lever valve can also be used in connection with various automatic pressure regulators. The smaller sizes are made of steam metal, the larger sizes of cast-iron, lined with steam metal.

Manufactured by Mason Regulator Co., Boston, Mass.

Hollow Spindle, 12-Inch Speed Lathe.

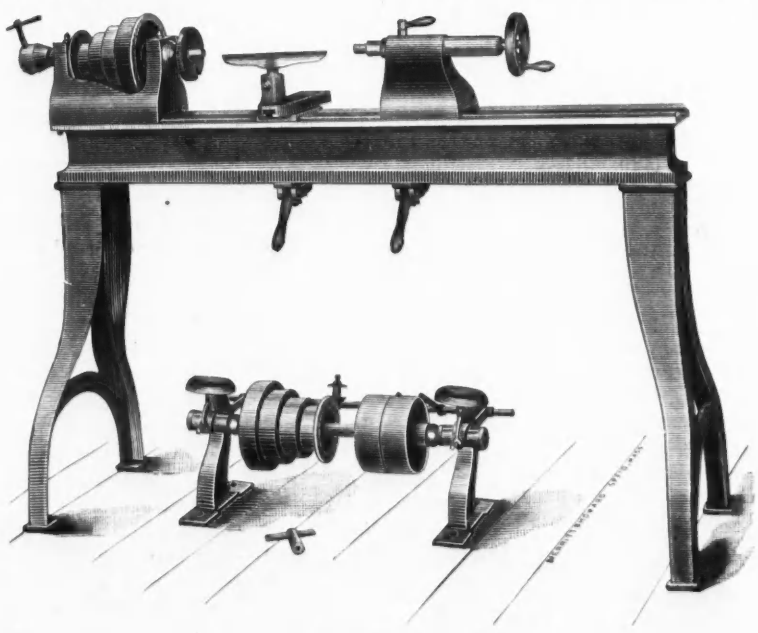
The speed lathe herewith illustrated is one built from entirely new patterns, by J. R. Rand, Brattleboro, Vt.

The live spindle has a hole through it, longitudinally, $\frac{3}{32}$ inch diameter; the spindle extends through the rear box, so that chucks and other special fittings may be used on either end.

The boxes are of peculiar design, so that wear may be taken up in all directions, to preserve the alignment; cast iron bronze or babbitt lined boxes furnished, if desired.

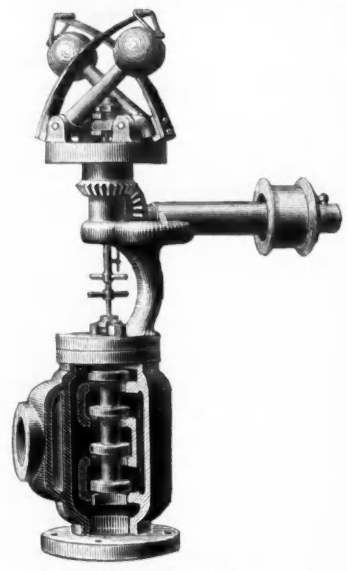
The shape of boxes is such that they can be replaced in any machine shop, perfect alignment of spindle resulting.

The tail spindle has motion of 6 inches, either by screw or hand lever. Everything is furnished complete, including countershaft, with cone and fast and loose pulleys, the loose pulley as well as boxes being self-oiling.



Hollow Spindle Speed Lathe.

The end thrust is sustained and adjusted by a solid collar and loose hardened ring, making adjustment easy.



Heald's Engine Governor.

Heald's Engine Governor.

In the construction of this governor the intention has been to make one of extreme sensitiveness, and one not subject to variation in the quantity of friction, which would destroy delicacy of action. The balls are light, but the velocity is high—500 revolutions per minute for all sizes—giving large regulating power.

The valve, as will be seen, is four-ported, giving large area of opening, with slight motion. The valve has no fit in the seat to cause friction, and being guided, top and bottom, the stem is not liable to be sprung.

The safety attachment is so adjusted that if the belt should break or run off, it instantly acts on the valve, and holds it in the same position that it occupied when the belt was on, the engine continuing to run at the same speed, thereby allowing time to repair and replace the belt, without instantly stopping the machinery and generally causing considerable trouble and damage. The attachment is adjustable to whatever speed it may be desired to run at, or change to, at all times having the engine under perfect control. All sizes of two inches and larger are made to receive the attachment.

The arrangement for changing the speed is simple, and the speed can be almost instantly changed to any desired extent.

All parts are made interchangeable, and can be duplicated without delay.

Jenkins Brothers, 71 John street, New York, are putting this governor on the market.

It is sometimes a knotty problem how to properly adjust mechanics' wages. Again in other cases it is plain what adjustment should be made. In New York city carpenters are paid $3.50 a day, but in Brooklyn they are paid only $3.00 a day. It costs as much for a mechanic to live in Brooklyn as in New York, and the carpenters of the former city struck for $3.25 a day, after being refused that figure by the builders. There is just as lively demand for carpenters in Brooklyn as in New York, and they ought to be as well paid in one city as the other.

The improvement in engine lathe construction, so far as the work that can be done in a given time is concerned, has within the past 20 years more than equaled progress in the steam engine.

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NEW YORK, APRIL 30, 1887.

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Unions to Face Unions.

It may be very soothing to those who have suffered by labor troubles to talk to them about arbitration as the great panacea for labor disputes. There is no doubt that arbitration is the high and noble way to settle the differences when both sides are ready to accept it and act upon the decision rendered. Unfortunately, however, they are seldom willing to trust to arbitration. What, then, is to be done? A contest is sure to bring more or less loss to both sides. It is a marked fact that where one strong union deals with another strong union, the one representing employers and the other the employed, strikes and lock-outs are of very rare occurrence. In nearly every trade the workmen are organized, but the manufacturers seldom are. Lately, however, they are forming their associations, as well the workers for wages, to act upon labor problems. At this late day it is useless to argue against trades unionism, for the more it is condemned the greater it becomes. If one union is destroyed another rises to take its place, usually with more solid adherence than the other. These are facts, whether unionism is a good or an evil, and it benefits nobody to try to cover up such facts in public print. With a union at one end of a labor dispute, and disunited industry mixed up with jealous rivalry at the other, it is hard to avoid a contest. Workmen are willing to trust each other in labor deals, and will sustain their organization, while manufacturers in the same line of business are kept apart by long nursed jealousies. It is time that these petty kinds of ill will were thrown aside, and unions formed by the different kinds of manufacturers on the same kind of foundation as the wage laborers have built so many structures. It is by organization, and not by efforts to break up opposite organizations, that disastrous labor contests can best be prevented. In the manufacture of stoves, for instance, strikes have been numerous and wasteful. The stove moulders have a strong national union. Recently a lot of stove manufacturers formed a union for mutual defense. A strike occurred in a St. Louis stove works belonging to the association. After examination into the matter the officers of the stove makers association ordered the patterns of the firm having the strike to be distributed among the establishments comprising the stove union, and the firm helped out with all their work while the strike lasts. This is a novelty in labor movements, but as it is union against union the contest is likely to be shorter and more decisive than it would be with one firm resisting a whole national union. It will probably lead to the preservation of more amicable relations in the future.

Manufacturers who are trying to suppress unions would do well to consider the desirability of forming unions themselves.

Elaborations on Steam Fire Engines.

In our "Letters from Practical Men" this week, F.G. Woodward calls attention to the superfluities often placed upon machinery for the sake of ornament. Some of them are a real annoyance, as they catch dust and oil and necessitate extra work to keep clean. The "thousand and one senseless elaborations" on the average style of steam fire engine is a good example which Mr. Woodward mentions. The modern locomotive has been well divested of superfluities, and yet as an attractive piece of mechanism it is far ahead of the super-ornamental machines that are used to put out fires. There is an adaptability of all its parts that favorably impresses, not only practical mechanics, but everybody with mechanical tastes.

The builders of steam fire engines could make some radical changes on their present Fourth of July designs with advantage. They could make these machines cost less without impairing their efficiency or durability. The decreased cost would be a greater inducement for almost any Board of Fire Commissioners to purchase than the excessive ornamentation. Only a few years ago many railroad managers seemed to take pride in having locomotives heavily trimmed with bright brass. This custom is now obsolete, and the change makes quite a saving in labor, while it loses nothing in any other direction. Let the steam fire engine manufacturers reform their superfluities, as locomotive builders have done.

We frequently receive letters asking for the name of the master mechanic of some railroad at a certain place, or the name of the superintendent of some well-known works. Not infrequently writers lose time looking for this information. A letter addressed to "Master Mechanic," with the name of road and location, or to "Superintendent" of a manufactory, with location, is all that is necessary to insure delivery.

A Business of Deception.

Those newspapers that defend the fraud of selling cotton seed oil for pure lard contend that the oil is cleaner and more healthful than lard, and more appetizing. If this be so it does not take away any of the false and fraudulent features of the transaction. Every case of the kind is actionable at law, with the right on the side of the purchaser. If one person sells another a quantity of rye flour for wheat flour, or wheat flour for rye flour, and the purchaser uses it in the belief that he has the article he bargained for, he has a cause of action against the seller just the same as though he had been deceived into buying cotton seed oil for lard. The defense that the article delivered and used under the deception makes more wholesome and healthful bread, is perfectly clean and pure, and is better for the purchaser to eat than the article he ordered and supposed he was getting, would cause a broad smile; yet it is precisely the same kind of defense held up to the public by newspapers lending their columns to bolster up the cotton seed oil fraud. They must think their readers either foolish or dishonest, to be convinced by any such clap-trap. Cotton seed oil is a good article for many purposes, but like some other commodities it may form the basis of fraudulent mercantile transactions.

What it is to be Famous.

In Washington they appear to have just heard of Keely. The *Post* says:

"A man named Keely claims to have invented a motor in Philadelphia which is propelled by etheric vapor. He says it will soon be finished. Stock is held high."

In New York there are a good many who heard of Keely some years ago, not entirely to their satisfaction; but then Washington is something more than a hundred miles from Philadelphia. Keely can stand this sort of neglect, but it's rough on Philadelphia. Men of genius ought to move out of the city.

Get a Substitute for Beer.

If the prohibitionists, who collect money to "fight the demon alcohol" by means of tracts and eloquent speeches, would observe workmen in hot weather, at hard manual labor, in the sun, they might discover that their task is one of the hardest when aimed against beer. While it may be open to question whether workmen are addicted to drinking whiskey more than any other part of the community, there is no doubt that they consume a large share of the beer that is brewed. Let a prohibitionist "put himself in his place" when he sees a hard-worked man driving a truck through a hot dusty street, and see if he would not feel a strong inclination to "take something" before he had completed ten hours' work. The radical prohibitionists would abolish beer, as well as whiskey and all other intoxicating drinks, without providing any substitute. In many cases this would seem to bring real hardship upon workmen. Theoretically it would be a great blessing, but so far as the workmen's beer is concerned we believe the bad results would be fully equal to the benefits, unless a good substitute should be provided. Establishing coffee houses for cool weather to draw workmen from the saloons would be a good movement for the temperance people, but what drink aside from ice water (which cannot be taken very freely) can take the place of beer in hot weather?

Immigration.

Dispatches from Europe indicate that there is to be a greatly increased immigration to this country in 1887. In view of the fact that there are more men here at the present time than can possibly find employment, the reason for this increased immigration is of interest.

It does not seem probable that, in these times, Europeans do not know of the lack of employment here; the only conclusion is that opportunities for finding employment here are better than in Europe.

It is an unfortunate, we might say, deplorable, condition, when men who are willing to work feel obliged to fly from greater to lesser evils, to better their condition; to go away from the possibility of getting work in Europe to the mere probability in this country.

In regard to the importance of the question of immigration, *The Sun* very truly says:

The immigration question will, therefore, probably become more and more prominent from this time forward. It is all very well to grow in population faster than any other country, provided there is work enough for everybody, at good wages; but when the labor conditions here approximate those of the lands from which the emigrants fly, the subject presents itself in a different light to the workers already in the republic.

The simple fact is that the United States has run amuck for the last fifteen years on the subject of immigration. Political parties have stretched the wings of the proverbial eagle to cover more than can get under them. Eventually the country will come to understand the difference between natural immigration and that which is stimulated by spread eagle logic. Those who come here with a certainty—in imagination—that they are to find paying jobs waiting for them will be sadly disappointed.

Any number of immigrants at the present time simply means a little more work by the employed to support a considerable percentage of those who come, and who will remain indefinitely unemployed. These are simple facts, and we commend them to the careful consideration of those who fix a money value on every emigrant who lands at Castle Garden.

The *Commercial Advertiser* says:

Incredible as it may appear, in one branch of industry there is a dearth of applicants for Government office. This is in the ranks of those who combine skill at stenography and type-writing. The Civil Service Commissioners say that every applicant who has any proficiency has been accepted. Men only are desired. Now that the notification has gone abroad, it is not likely that the scarcity will continue.

We do not believe the last clause in the above. Stenography and type-writing are both occupations requiring skill. Those who have skill in these lines are not likely to be found pestering Government for "positions." No genuine mechanic can afford to get into the circumlocutionary Government rut that swathes a man into a condition of everlasting mummified unprogressiveness.

There will be plenty of politico-stenographers and type-writers looking for these positions, but unfortunately mechanics do not hanker after them.

The *Milling World* notes the fact that strong competition is using American flour-makers hard. Well, this is the case with all manufacturing. It is healthful in a degree, but carried too far it is a positive injury. Competition in some branches of industry in this country does nothing but cut down profits and wages, and does not result in good to a single individual in the world.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(196) A. J. H., Algiers, La., writes: Having noticed on several occasions locomotives humming, especially when the blower is put on, which I have always attributed to a hole in the fire, would you please inform me (if not right) what the cause of it is? *A.*—When the blower is put on, the humming noise may be caused by a hole in the fire, or by leaving the fire door open; and it may also be caused by the steam from the blower striking the cone in the chimney, or the draft-pipe in the smoke-box.

(197) S. W., Brussels, Ont., asks: 1. Why do piston rings need scraping? *A.*—Some kind of piston rings need scraping; others do not. The ordinary three-ring piston packing is generally scraped, because there is not motion enough to the packing to wear itself tight. 2. Where in the cylinder is there the most wear on piston rings? *A.*—Generally at the ends. 3. How do pistons work and act when low in the cylinder, and can it be seen on the slides? *A.*—When the piston is low, the rod wears the gland on the bottom; if the crosshead is moved to the end of the slides most remote from cylinder, the rod will be seen to be out of line, up and down, with slides.

(198) W. G. J., Chattanooga, Tenn., writes: In answer to question 169, on proportion of boilers for natural draft, you say one square foot of heating surface will give 23 cubic feet of steam per hour at 100 lbs. pressure. Taking your figures by which you get 819 square feet of heating surface for the production of a certain number of cubic feet of steam of 100 lbs. pressure, will it be right, if I want to make the same number of cubic feet of steam of 80 lbs. pressure, to find the heating surface by proportion, as follows: 100 : 819 :: 80 is to heating surface required? *A.*—The pressures given are above atmosphere; hence you should add the atmospheric pressure, say, 15 lbs., making the proportion: 115 : 819 :: 95 is to heating surface required.

(199) M. D. H., Lorain, O., asks: What can I use to cement tracing linen to a board securely without discoloring the tracing? *A.*—First varnish the face of the tracing with a solution of white shellac and alcohol, and then hang up to dry; when dry, spread over the back of the tracing a solution of gum arabic and water or ordinary mucilage, and paste the tracing to the board. The idea of varnishing the tracing before it is pasted to the board is to prevent the lines from blotting when the tracing becomes damp by putting on the mucilage. Separate brushes should be used for the varnish and mucilage, and another brush kept perfectly dry for spreading the tracing over the board. Each of these brushes should be thin and about three or four inches wide. Some practice will be necessary to paste the tracings evenly on the board.

(200) A. F., Mt. Olive, Ill., asks: 1. Knowing the initial pressure and point of cut-off in an engine, how can I find the terminal pressure? *A.*—Divide the initial pressure by the ratio of expansion. Thus, if steam of 100 lbs. absolute pressure is cut off at ¼ stroke, the terminal pressure will be 100÷4=25 lbs. absolute. 2. What objection is there to an iron body and brass cock for a blow-off valve? *A.*—Difference in expansion between the two metals will be likely to cause leakage. 3. Suppose I have an engine, plain slide valve, whose eccentric is correctly set, but the valve has slipped on the rod so the engine exhausts heavy on the crank end, how can I fix it temporarily so as to be nearly correct? *A.*—Put the crank on either dead center, and open the cylinder cock on that end, moving the valve till steam will just blow through. 4. What is the horse-power of an engine with steam pressure 80 lbs., cut-off at ¾ stroke, the engine being 7″x12″, and running 200 revolutions? *A.*—We can tell nothing about it from the data given. Apply an indicator, and you can find out. 5. What grate area should I allow for a boiler 48 inches by 20 feet, with two 14-inch flues? *A.*—One square foot grate area for each 30 feet of heating surface.

(201) G. D. B., ——, writes: We have an old-fashioned steam fire-engine here of the following dimensions: The pump is horizontal, the steam cylinder 8″ in diameter, the water cylinder 4″, and the stroke 12″. The boiler is an ordinary vertical one, with the exception that the fire-box portion, instead of being cylindrical, is square. The upper part of the boiler is 28″ in diameter, and the outside of fire-box is 28″ square; the inside of fire-box is 23⅞″ square, and 18″ deep from under-side of tube sheet to bottom of mud ring. The water space around the sides of the fire-box and over the corners of the lower tube sheet is 1⅛″ wide. The feed (cold) enters the boiler on the water leg about 1″ above the mud ring. There are 110 tubes 1¼″ in diameter, 42″ long, set 2″ from center to center. The smoke-stack is 12″ in diameter and 14″ high, the base of the stack being 15″ above the upper tube sheet. The exhaust nozzle is 2″ in diameter, and set 3″ below the base of the stack. The fuel we have been using is dry pine wood. As we have never been able to get steam enough from the boiler, we propose to substitute cannel coal for wood; to put on a new smoke-stack, 9″ in diameter and 30″ high, also reducing the exhaust nozzle to 1¾″. As this arrangement will cause a greater temperature both in the fire-box and in the smoke bonnet, we would like to find out—1. Will there be any danger of burning the fire-box plates owing to the contracted water space around them? *A.*—If you keep the water space clean and free from mud, we believe there will be no danger of burning the fire-box plates. 2. Will the upper ends of the tubes be liable to be seriously overheated, the water line being carried 28″ above the flue sheet? *A.*—No. 3. Will the position of the feed-water connection on the boiler be liable to cause leaky or cracked fire-box plates, or would it be advisable to have the feed-water enter at some other point? If so, what would be the best location? *A.*—If the feed-water is heated before it enters the boiler, the fire-box sheets will not be injured; but if the feed-water enters cold, leaky or cracked fire-box sheets must be expected. We believe that to heat the feed-water a good way would be to run it through a coil of pipe placed over the upper flue sheet, and then lead the water to the check valve outside of the boiler, as arranged at present. 4. How much coal will we be able to use per hour? *A.*—That depends greatly on the force of the draft; you will probably be able to burn from 12 to 20 pounds per square foot of grate surface per hour. 5th. Is there any simple and inexpensive method by which we con improve the circulation of the water in the water legs? *A.*—No.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Geo. B. Grant's adv., page 16.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

AirCompressors,RockDrills. J.Clayton,43 Dey st.,NY

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 93 John st., N. Y.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Mach'y Patterns, Wood and Metal; send for estimates. J. Valentine, 15 Alling st., Newark, N. J.

Extra capacity, hollow-spindle Hand Lathes; correspondence solicited. J. R. Rand, Brattleboro, Vt.

Robbs' Patent Composition for case-hardening, send for circular. F. W. Tasney, Paterson, N. J.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

20″, 25,″ 28″ B.G.and S. F. upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

Ice and Refrigerating Machines. 125 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt,38 Cortlandt st., N.Y

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N. Y.

Veneer Machines, with latest improvements. Farrel Fdy. & Mch. Co., Ansonia, Ct. Send for circular.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

The Holly Manufacturing Company, of Lockport N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

New Book on Gears; Tables giving 3,094 diameters, with rules for calculation of movements of shafts, etc.; sent on receipt of P. O. Note; price 50 cts. Address C. B. Long, M. E., Worcester, Mass.

Practical Handbook on Pump Construction. Various kinds and materials to be made of for different purposes. By P. R. Bjorling. Nine plates, 12mo., $1.50. E. & F. N. Spon, publishers, 35 Murray street, New York.

"Indicator Practice and Steam Engine Economy.' By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the American Machinist. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Pub'g Co., 96 Fulton st., New York.

Manufactures.

D. J. Elliot will erect a machine shop at Bristol, Tenn.

J. A. Montgomery is negotiating for the location of car works at Leeds, Ala.

Samuel Doughty, Newark, N. J., will build a wagon shop at 310 Ferry street.

The J. I. Case Company, Racine, Wis., will build extensive additions to its plow works.

There are prospects of a large sash, door and blind factory being erected at Birmingham, Ala.

R. G. Salomon, Newark, N. J., will build a six-story brick factory, 60x86 feet, at 14 Nesbit street.

Sanderson's Steel Works at Syracuse, N. Y., recently burned, will be rebuilt at a cost of $100,000.

Efforts are being made to organize a stock company to build a large cotton mill at Louisville, Ky.

The Black Giant Belting Company, Yardley, Pa., will erect a building for the manufacture of belting.

C. C. Walker, Washington, D. C., will build a $7,000 factory on L street, between 25th and 26th streets.

Harrison, Me., will have a woolen mill some time the coming summer. Stock has been taken to insure building.

A depot, machine shops, etc., are to be built by the Wichita Falls and Winfield Railroad Company, at Wichita Falls, Tex.

Charles Tippie has contracted to erect the buildings for the works of the Ivens & Sons Machinery Company at Decatur, Ala.

The Decatur Land, Furnace and Improvement Company, Decatur, Ala., are negotiating for the location of a rolling mill.

C. A. Graham and others will build a cotton factory, 208 feet long, at Asheville, N. C., to cost $100,000, work to begin at once.

A shoe factory will be built in Great Falls, N. H. H. F. Dixon, Frank P. Reeves, John W. Bates, and Perry Watson are interested.

Harry C. Nichols, Philadelphia, Pa., will erect a three-story factory, 48x75 feet, on Brown street, between 26th and 27th streets.

The Hoosier Drill Implement Company, Richmond, Ind., intends to move to some place farther West and erect a larger plant.

D. T. Parker has been elected president, and S. H. Smith, secretary and treasurer, of the Anniston Pipe Works, Anniston, Ala.

The Pittsburgh and Lake Erie Railroad will erect machine shops and round-house at Chartiers station, Pa., at a cost of $75,000, this summer.

The Ohio Iron Wheel Company have made a proposition to build a branch factory at Fort Smith, Ark., which, it is said, has been accepted.

It is stated that A. T. Biers, of Springfield, Ill., has purchased 1,300 acres of land, and will erect large works to manufacture engines, at Fort Worth, Tex.

The Hazen Manufacturing Company, Cincinnati, Ohio, will erect a four-story, 70x150 feet, brick and stone factory, for the manufacture of wire nails and hardware.

A company has been formed to build a large wagon factory at Selma, Ala. The Selma Land, Improvement and Furnace Company can give information.

A company was organized at Selma, Ala., April 2, to build a $500,000 rolling mill at that point. Mr. Peacock, of Pittsburgh, Pa., is one of the largest stockholders.

F. W. Wagener & Co., Charleston, S. C., are interested in the establishment of a cotton factory at Laurens, to cost $200,000, the town to raise one-half the amount.

The Pennsylvania Steel Company, of Steelton, Pa., have purchased 600 acres of land on the Chesapeake Bay, near Baltimore, and will erect large steel works, including blast furnaces.

The new bloomery of Morrison Bros. & Co., at Anniston, Ala., will have a capacity of 20 tons daily. The product will be a high grade of iron for cotton ties, horseshoes, car axles and boiler plates.

The Carbon Iron Company, with its principal office in New York city, has just completed the purchase, for $250,000, of a plot of ground in Pittsburgh, where the works of the company are to be erected.

E. P. Howell, Geo. W. Adair, Henry S. Tompkins and others have organized the Atlanta Manufacturers' Improvement Association at Atlanta, Ga.—capital stock, $150,000—for the purpose of encouraging manufactures.

The Philadelphia, Wilmington and Baltimore Railroad Company (office, Philadelphia, Pa.) are making surveys for an extension of their road from Bayview Junction to Tivoli, where large steel works are to be located.

Stock companies have been formed at Tyler, Tex., to erect cotton factory and oil mill. The city council is about to enact an ordinance exempting from taxation all manufacturing enterprises for the period of fifteen years.

The Troy Steel and Iron Company, Troy, N. Y., have elected William Kemp president in place of Chester A. Griswold, who was first elected to the position two years ago, soon after the articles of incorporation had been filed.

The Cleveland Axle Manufacturing Company's works at Cleveland, O., have been sold to a new company, of which George A. Laughlin, of Wheeling, W. Va., is president. The company is incorporated with a capital stock of $100,000.

Henderson Bros., Waterbury, Conn., have issued an illustrated catalogue of tumbling barrels for foundries. They make an exhaust barrel of their own design, which, connected with a blower, drives the dust out at one end. Plain barrels are also made.

Negotiations are in progress looking to the removal of the works of the London (Ontario) Machine Screw Manufacturing Company from London to Ingersoll. The Board of Trade of Ingersoll offers a bonus of $2,500 on condition that the company employ 20 men.

A. & F. Brown, of this city, are about to start a new foundry in Elizabethport, N.J., as their business of making pulleys, shafting, hangers and machinery has outgrown their present works. They will in time remove the most, if not the whole, of their works to Elizabethport.

The town of Kennebunkport, Me., has voted to raise $6,000 to erect a building for municipal and other purposes, a part to be used for some kind of a manufacturing enterprise. W. H. Sawyer, F. G. Cousens, J. B. Maling, Octavus Hutchings and C. S. Perkins were chosen trustees.

The Fort Worth Machine and Boiler Works, Fort Worth, Tex., will build new works at a cost of about $100,000. Plans have been prepared, and work will shortly begin. The foundry will be 60x100 feet; the machine shops, 50x150 feet; and the blacksmith shop, 40x50 feet.

The Alabama Rolling Mill Company—capital stock $250,000—has been organized to build a 60-ton rolling mill about four miles from Birmingham, Ala. Machinery is now being purchased. Fred. Sloss is president; W. H. Hassinger, vice-president and general manager; and D. M. Forker, secretary and treasurer.—*Baltimore Manufacturers' Record.*

The Marion Thresher and Separator Company has been organized at Marion, Ohio, with B. F. Waples, president; J. W. Stringer, vice-president and general manager; Fred. Haberman, secretary; H. Ackerman, treasurer; and F. Strobel, superintendent. They will manufacture threshing machines, clover hullers, engines, tile and brick machines and general machinery.

J. Wendell Cole, manager for the Detroit Emery Wheel Company for Pennsylvania, Lower Lake region and the Northwest, has issued a neat, small-page catalogue of emery wheels and emery wheel machinery—red line edition. Emery wheels are not used as much as they ought to be, but their use is increasing. The address of Mr. Cole is Box 84, Columbus, O., or Box 152, Chicago, Ill.

The Albany Iron Works, near Albany, N. Y., which cost a million dollars, were sold at auction Tuesday, for $125,000, to J. Howard King and Dudley Olcott. The property in the town of Bethlehem is assessed at $130,000. There is also a lease for 999 years of an ore bed in Berkshire Co., Mass. The island property comprises two blast furnaces, a large manufacturing building, engines, locomotives, trestles, etc., 25 acres of land, and some land under water.

The Hardware Manufacturing Company, of Akron, O., has been organized. The capital stock is $25,000, and the incorporators are N. T. Tibbias, James T. Diehm, J. F. Case, Henry Feuchter, J. G. Eberhard and Eli Conn. The object is the manufacture of specialties in hardware and patented crystal harness carriage trimmings. They have secured the works owned by J. G. Eberhard, and which have been occupied recently by Peck & Dempsey, Foundry and Machine Company, and the two-story brick building adjoining.

A public meeting of the citizens of Whitehall, N. Y., was held recently to decide whether or not to give inducements to the Dale Silk Manufacturing Company to locate at Whitehall. The company will employ about 300 persons. The meeting decided to accept the company's offer, and money to the amount of about $18,000 was subscribed as a loan to erect buildings to be occupied by the firm, in addition to the large six-story building of the water power company. A large amount was subscribed to be given the company to pay for the expense of moving machinery and tools.

The following sales of boilers were made by the Babcock & Wilcox Company during March, 1887: Singer Mfg. Co., Montreal, Canada, 152 horse-power; United States Senate, Washington, D. C., 312 horse-power; E. Jenckes Mfg. Company, Pawtucket, R. I., 240 horse-power; Cardenas Sugar Refinery, Cardenas, Cuba (sixth order), 208 horse-power; Tennessee Coal, Iron and R.R. Company, So. Pittsburgh, Tenn., 624 horse-power; Gadsden Furnace Company, Gadsden, Ala., 624 horse-power; Gordon, Strobel & Laureau, Limited, Philadelphia, Pa. (fifth order), 480 horse-power; the *Journal* Company, Kansas City, Mo., 200 horse-power; J. Langdon & Co. Inc., Shamokin, Pa., 208 horse-power; Metropolitan Street Railway Company, Kansas City, Mo., 600 horse-power; Francis Axe Company, Buffalo, N. Y. (third order), 61 horse-power; E. C. Knight & Co., Philadelphia, Pa. (third order), 480 horse-power; Dalzell Axle Company, South Egremont, Mass., 122 horse-power; National Tube Works Company, McKeesport, Pa., 156 horse-power. This makes a total of 4,467 horse-power.

Machinists' Supplies and Iron.

NEW YORK, April 14, 1887.

Iron—There is slight improvement in the demand for small lots of American pig; nothing in a way likely to materially affect prices, but a demand in a direction that will tend to stimulate producers. We quote: No. 1 X Foundry, $22 to $23: No. 2 X, $20 to $21; Grey Forge, $18 to $18.50.

Scotch Pig—The market for these brands has not shown any quotable change.

✲WANTED✲

"Situation and Help" advertisements only inserted under this head. Rate, 3c. cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

First-class lathe and floor hands. Apply to Betts Machine Co., Wilmington, Del.

Wanted—A first-class designer and draftsman of wood-work'g m'ch'y. Address "M.," AM. MACHINIST.

Wanted—A competent man to superintend a shop building automatic engines. Address Keystone, care AM. MACHINIST.

A man with theoret. and practical experience wishes situation as designer or foreman of drawing room. Address M. E., AM. MACHINIST.

Wanted—Two machinists; also one accustomed to steam fitting, piping, etc.; also two die-sinkers. Address F. V., Jones United Zylonite Co., Zylonite, Mass.

Executive position wanted by a technical graduate with 6 years practical experience; good designer and machinist; excellent references. Address G. W., care AM. MACHINIST.

A mechanical engineer and superintendent of long experience with steam and hydraulics, and general heavy machine work, is open for engagement; reference if required. Address D. E. H., AM. MACHINIST.

A mech. draftsman, with college education, who has served four years in different shops and seven years at the drawing board, wishes suitable position; references furnished. Address Future, AM. MACHINIST.

Wanted—A foreman for a machine shop employing about twenty hands; must be a first-class mechanic, of good executive ability and a fair draftsman. Address, stating age, reference, etc., Box 25, AM. MACHINIST.

Wanted—Situation by a young man, aged 23 years, as patternmaker in an inland town not more than 100 miles from N. Y. city; has worked 7½ years on general machy. and engine work in New York city. Address B. L. W., AM. MACHINIST.

A mechanical engineer, of first-class practical and scientific attainments, as well as of unusual inventive ability, desires a position as engineer, superintendent or chief draftsman; reference first-class. Address Ajax, care AM. MACHINIST.

Want to correspond with iron foundry foremen with a view to engagement; those who are accustomed to machinery castings and have had some experience in making chilled and hard iron castings preferred. Address, stating age, present position and references, X, AM. MACHINIST.

A first-class foreman patternmaker and millwright wishes to change his position; thoroughly understands general machinery and intricate core work; can show positive proof of energy, executive and mechanical ability. Address P. & M., AM. MACHINIST.

Foreman wanted; experienced, first-class machinist, thoroughly familiar with modern tools and appliances, to superintend the construction of high-speed automatic engines; must have ten to fifteen thousand cash to take an interest in well-established and profitable business. Address Box 18, AM. MACHINIST.

I desire to hear from some New England concern who may need the services of a young man as head draftsman, engineer or superintendent, posted in modern shop practice, and familiar with those branches of the trade pertaining to the production of machine tools, articles with interchangeable parts or light automatic special machinery. Address Box 26, AM. MACHINIST.

We desire the services of a thoroughly competent man to take the place of our present secretary, who is obliged to retire on account of ill-health, and to assist in general management; experience and first-class business qualifications will be required, and to the right person excellent inducements will be offered. Great Western Mfg. Co., mill furnishers and man'f'rs of general machinery, Leavenworth, Kansas.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, Ohio.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co., Cleveland, O.

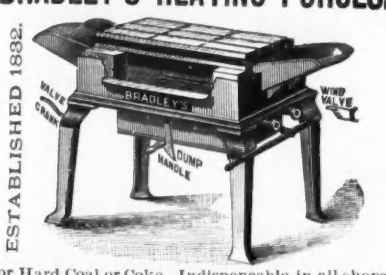
Light mach'y of all kinds built at short notice Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. I. A. Weston & Co., Syracuse, N. Y.

Adhesive Adamantine stops leaks in boilers, drums and cracked castings; prevents pitting; circular. 38 and 40 Sycamore st., Cincinnati, Ohio.

For Sale—Low figure, in good order, four stationary engines—one each of thrty-five, forty, fifty and sixty horse-power. Address Pratt & Letchworth, Buffalo, N. Y.

BRADLEY'S HEATING FORGES.

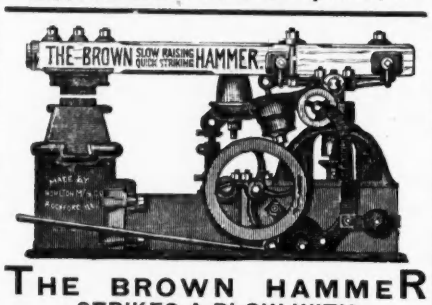


For Hard Coal or Coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

BRADLEY & CO. Syracuse, N.Y.



THE BROWN HAMMER
STRIKES A BLOW WITH
Double the Velocity That it Raises the Hammer.
A NEW MOVEMENT! SEND FOR DESCRIPTION.
ENOWLTON MFG. CO., KING ST., ROCKFORD, ILL.

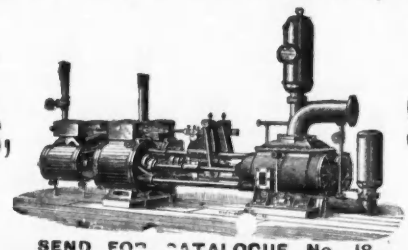
GUILD & GARRISON,
BROOKLYN, N. Y.
STEAM PUMPS,
VACUUM PUMPS,
AIR COMPRESSORS.
SEND FOR CATALOGUE.

STEPHENS PATENT VISES.

ONE-HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular
TOWER & LYON,
95 Chambers Street, New York.
Successors to MELVIN STEPHENS.

THE DEANE STEAM PUMP CO., Holyoke, Mass.

BUILD Water Works, ENGINES AND Steam Pumping MACHINERY.



SEND FOR CATALOGUE No. 18.

TRAVERSE SHAPERS.

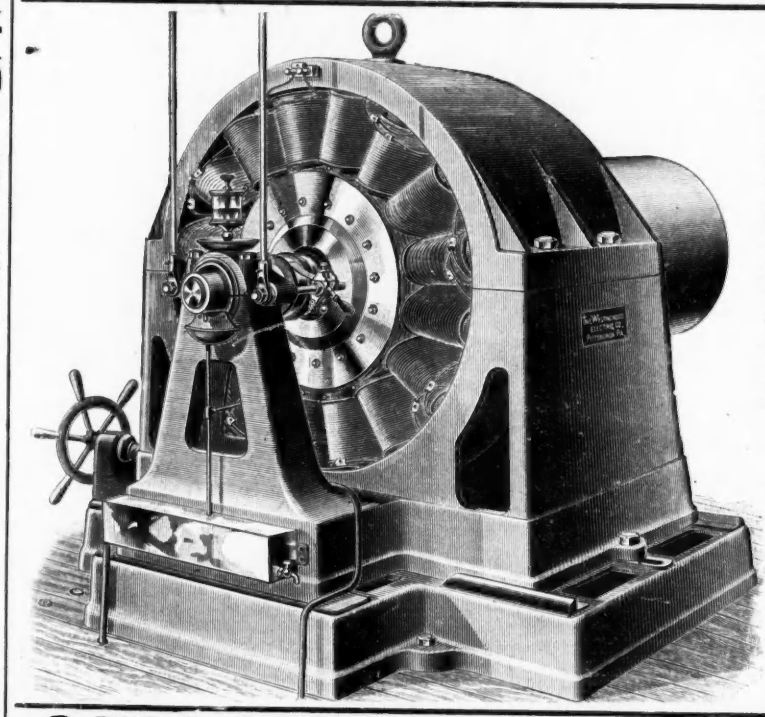
15	inch	stroke	x 27	inch	Traverse.
20	"	"	x 60	"	"
30	"	"	x 72	"	"

As noted above, we build 3 sizes of Traverse Shapers and can make the beds any desired length to suit special work. They are all stiff solid tools with a very deep bed. The two larger sizes have each 2 tables, a large heavy graduated swivel vise and automatic, vertical, angular and horizontal feed. The circular arbor also has independent feed. Screws and shafts are of steel and bearings are of hard bronze. The rack gear and pinion and other small gears are of steel. Our illustrated catalogue gives full description, and we shall be pleased to send them to those who are interested.

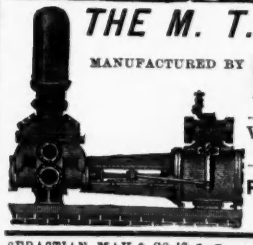
THE HENDEY MACHINE CO., TORRINGTON, CONN.

THE ALTERNATING SYSTEM.

THE WESTINGHOUSE ELECTRIC CO.
Eastern Office, 17 Cortlandt St., New York. PITTSBURGH, PA.



THE M. T. DAVIDSON IMPROVED STEAM PUMP,
MANUFACTURED BY
DAVIDSON STEAM PUMP COMPANY.



WARRANTED THE BEST PUMP MADE FOR ALL SITUATIONS.
PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.
NEW ENGLAND OFFICE, 51 OLIVER STREET, BOSTON, MASS.

SEBASTIAN, MAY & CO.'S
Improved Screw Cutting
FOOT or POWER LATHES.

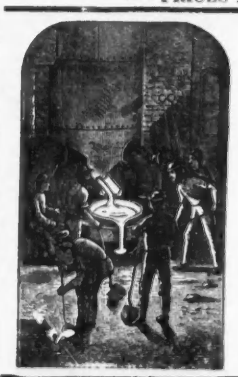
Catalogue of Lathes, Drill Presses and Machinists Tools and Supplies mailed on application. *Lathes on Trial.*
167 W. Second St., CINCINNATI, O.

If you want an
ENGINE
FOR ELECTRIC LIGHT OR ANY OTHER SERVICE.
For which an automatic is suitable. Read the article on 3d page of AMERICAN MACHINIST of February 12th, 1887 (Vol. 10, No. 7), and write to
COOKE & CO.
22 Courtlandt Street, New York.
Stating the size wanted and service required, and you will obtain lower prices for a **thoroughly first-class engine,** than you can get elsewhere.

VERTICAL BOILERS, 5 to 23 H. P. in stock.
—PRICES LOW.—

Lynde's Pat.
Pop Safety Valves,
Adapted to all Boilers.
J. E. Lonergan & Co.,
Sole Owners and Manuf'rs
PHILA., PA.

"THE SWEETLAND CHUCK"
IS UNEQUALED FOR ACCURACY, STRENGTH, Durability & Simplicity
Send for catalogue of
Chucks, Stamps, Belt Clamps, Machinists' Tongs, &c., &c.



T. SHRIVER & Co's
IRON FOUNDRY,
333
East 56th St.,
NEW YORK.
Contracts Solicited for Machinery Castings in regular supply.

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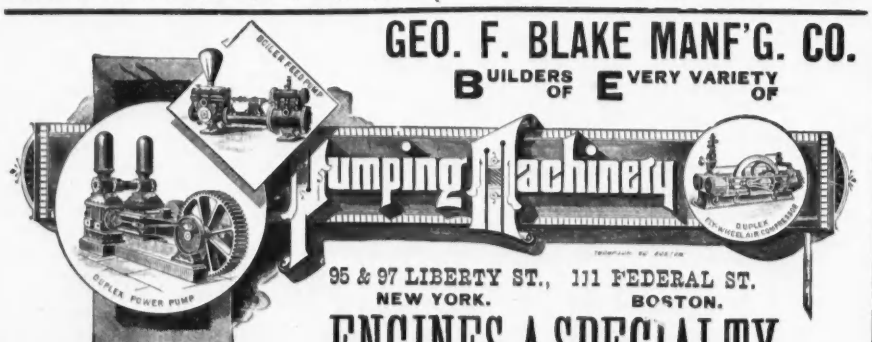

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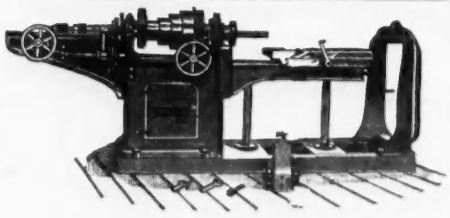

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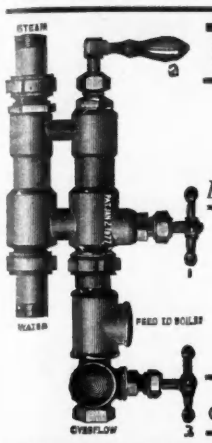

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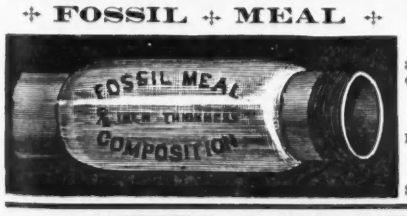

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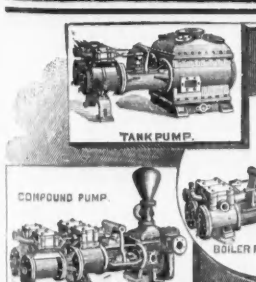

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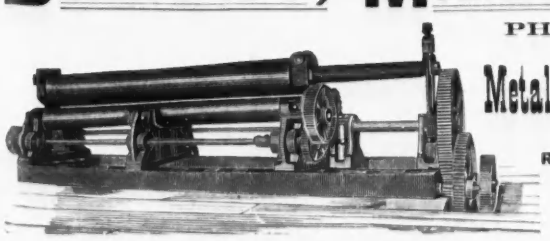

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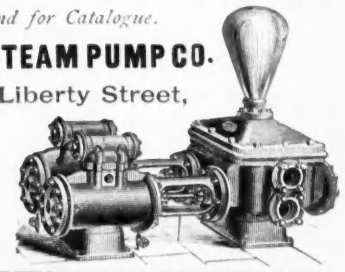

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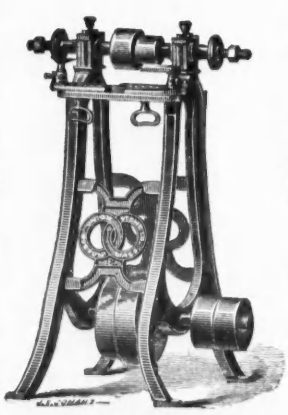

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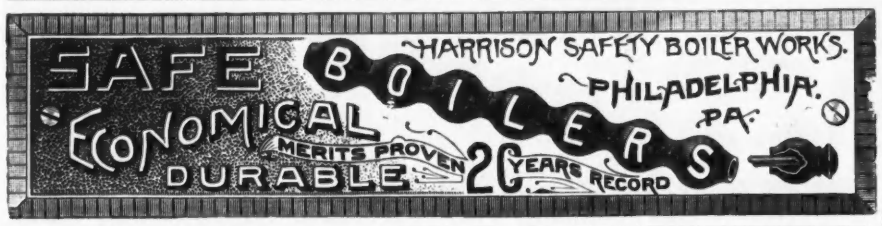

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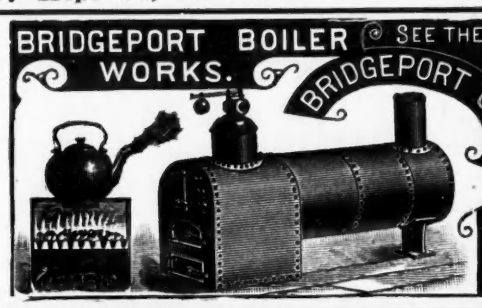

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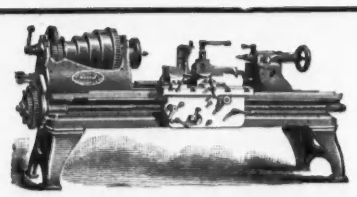
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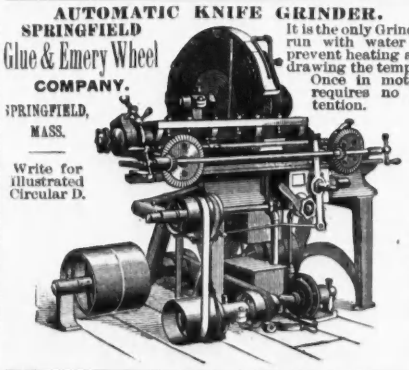
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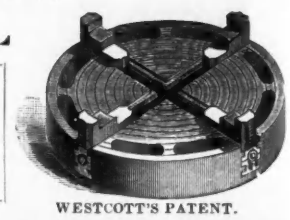
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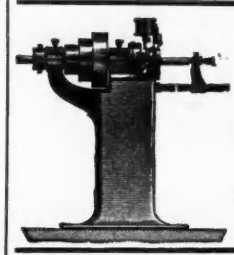
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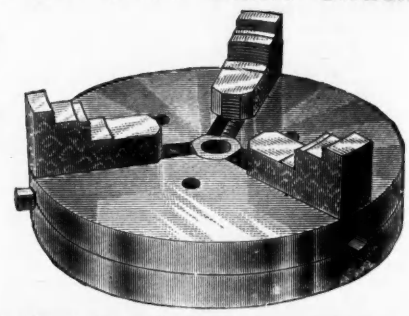
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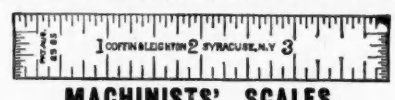

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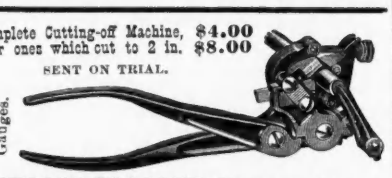
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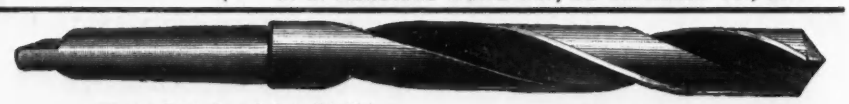
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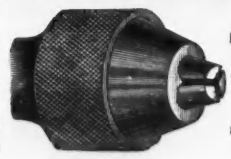
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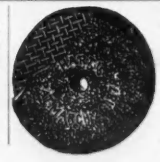
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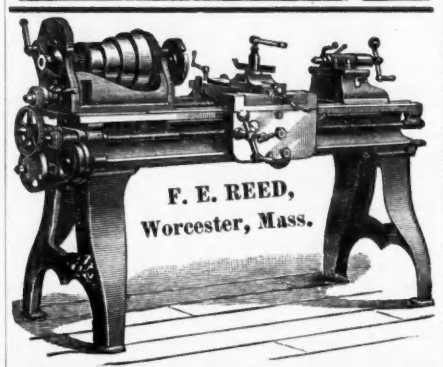

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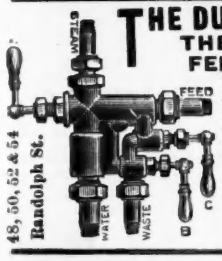

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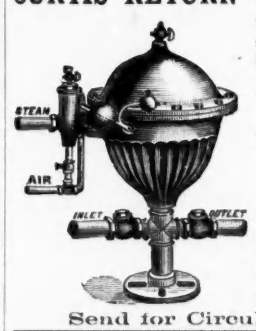

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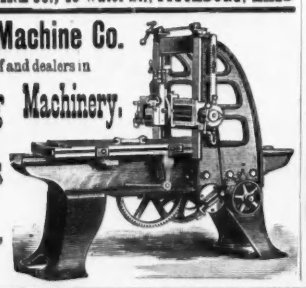

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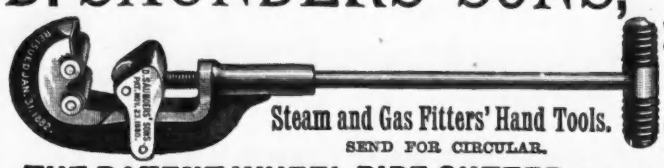

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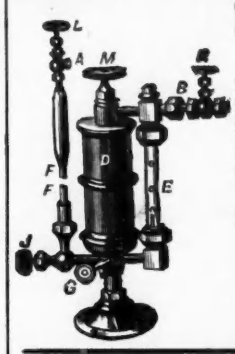

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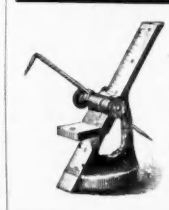

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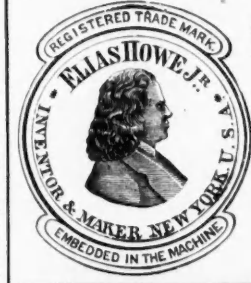

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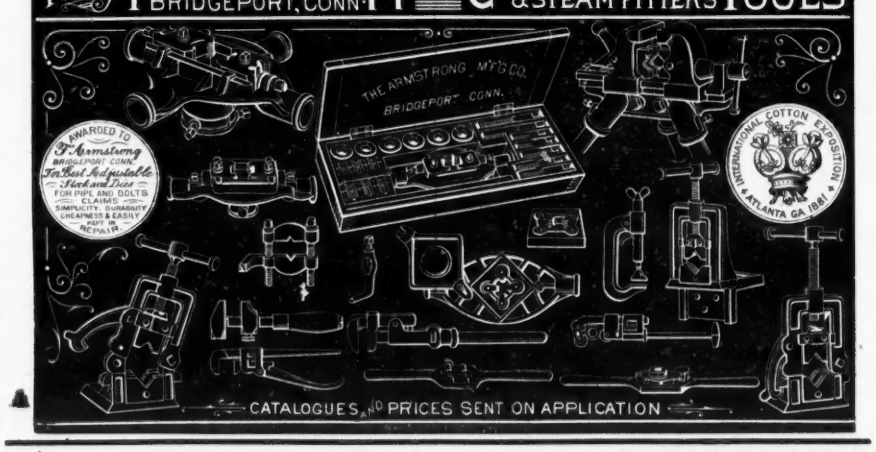
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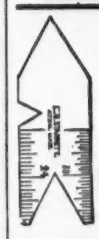

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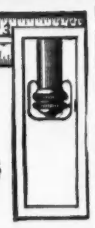

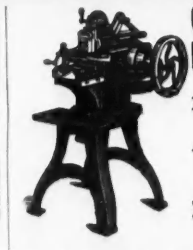

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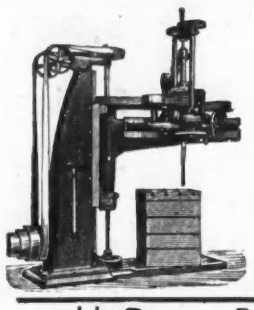

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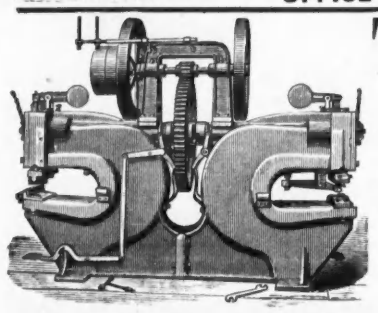

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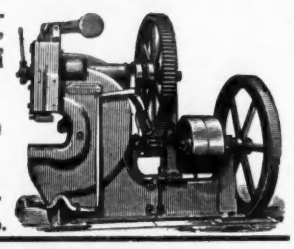

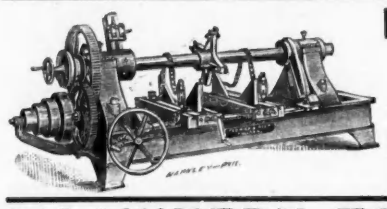

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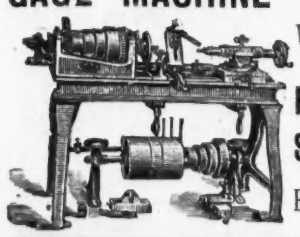

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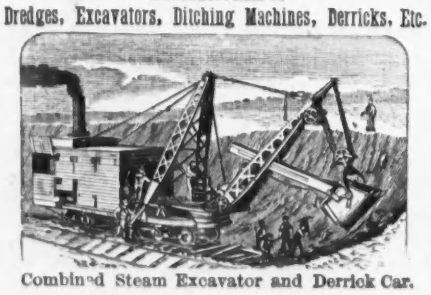

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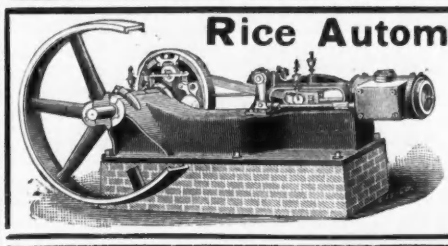

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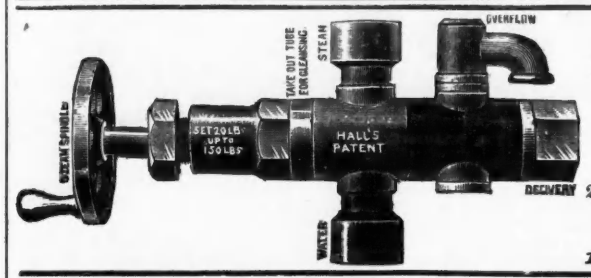

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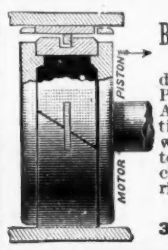

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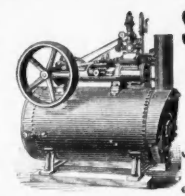

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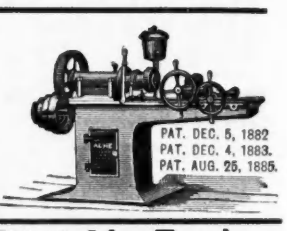

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This Hammer possesses advantages superior to any other in the market. It has neither cylinders, valves or piston rods, consequently repairs are trifling. It takes up less space, less power to drive; strikes much harder and truer blows than hammers with double the weight of ram.

It can be worked to strike good alternate blows on a 3-inch and ⅜-inch bar when a 100-pound hammer is used, and can be used on die work to a far greater advantage than any other hammer known. Manufactured by the

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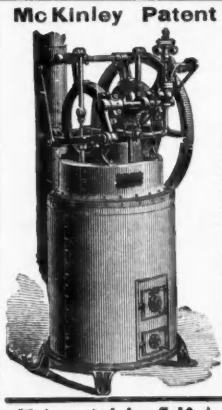

The Best and Cheapest on the Market.

No Steam. No Water. Absolute Safety. No Engineer. No pumps. No Gauges. No liability to freeze up. No Regulation required.

NO EXTRA INSURANCE.

Can be used for any purpose where power is required.

Cheap Fuel. Cheap First Cost.

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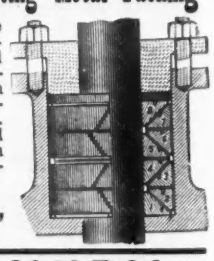
Katzenstein's Self-Acting Metal Packing

For Piston Rods, Valve Stems, etc., of Steam Engines, Pumps, etc., adopted and in use by leading engine builders, mills, iron works and steamship companies all over the world. Also flexible tubular metal packing for slip joints on steam pipes, and for hydraulic pressure.



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The Fisher Double Screw Leg Vise.—Warranted stronger grip than any other Vise. Always parallel and cannot be broken.

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Two 16" swing, 6' bed, Engine Lathes (Porter), new.
" 17" " 8' " " " " (Wright), "
One Pond Planer, 22"x22"x5' second hand.
" Gray & Woods Dimension Planer, 22" wide, 14' long, second hand.
Two 65 H. P Stationary Boilers, second hand,
One 60 " " " " "
" 50 " Portable " " "
" 35 " Center Crank Engine, new.
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" 20 " Coil Boiler, suitable for a yacht.
" 12 " Vertical Engine, new.
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" Hand Planer, 18' x18"x24" second hand.

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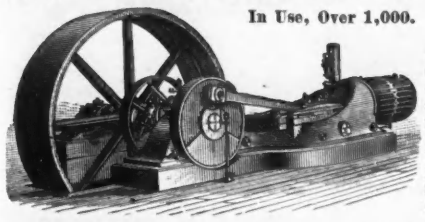
NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. **25 to 1,000 H. P.**



These Engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

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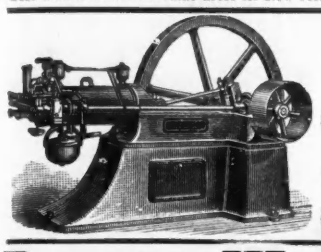
Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.



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OVER 20,000 ENGINES IN USE.

GUARANTEED To Consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work.

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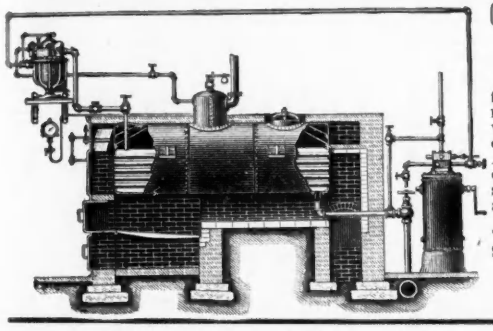

Guaranteed to Absolutely Prevent Formation of Scale in Steam Boilers.

Automatically takes water from the boiler, filters it, and returns it in pure condition, thus removing scale-making impurities from the water, and maintaining a free and steady circulation. Combines the well-known Albany Steam Trap with a Filter of novel construction, which has no rival in point of simplicity, facility for cleaning, and assurance against clogging of sand valve.

We also manufacture the **Albany Steam Traps and Blessing's Patent Renewable-Seat Stop and Check Valves.** Send for Circular.

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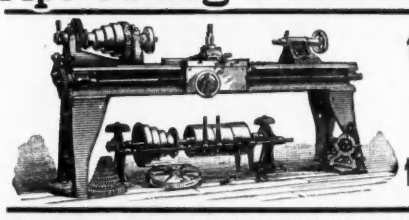
Pipe Cutting & Threading Machines

FORBES & CURTIS, Bridgeport, Ct.



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NEW DESIGNS FIRST CLASS WORKMANSHIP.

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FOR HEAVY WORK AND LARGE POWERS.
EXTRA HEAVY DESIGN.
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PORTABLE AND STATIONARY
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Send for Catalogue and Prices.

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The Machine Tool Business of

E. P. BULLARD,

AND THE

Bridgeport Mach. Tool Works

Established at **14 DEY ST.**, in 1875, has been **REMOVED** to the new and commodious stores,

72 WARREN ST., AND **62 COLLEGE PLACE,**

Near Chambers St. Station of the Sixth Ave. Elevated R. R.

Send for New List of Tools for immediate delivery.

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To Buyers of Engine Lathes

We are now making from entirely new designs, *extra heavy* 19″ and 21″ Engine Lathes (the most popular sizes), of which we are making a specialty, and manufacturing in lots of not less than 100 at a time.

We make no charge for extras. Every lathe is furnished with *hollow spindle*, the 19″ with 1⅝″ hole, and 21′ with 1⅞″ hole. Every lathe has substantial *compound rest*, heavy tool post (bar steel), rest to turn full swing, *following rest* with adjustable jaws to take any size from 2¼″ down, with extra tool for shafting.

Full set of gears to cut from 2 to 18 threads including 11½ pipe thread. *Automatic stop on carriage. Separate screw and rod feed*, and the most substantial and easily managed *taper attachment* made. Cones and gears of large diameter and wide belt. Studs, screws and small gears are *steel or gunmetal*. Webbed live heads, heavy tail stocks. No worm or worm gears, no weak reverse plate. *Perfect lubrication for all running parts*, including carriage.

Lead screw inside of shear, double nut (cut from solid), and taking hold of carriage directly under the line of strain. Friction counter-shaft, the most durable made. Our prices are reasonable for cash, and from which no deviation will be made. Our written guarantee accompanies every lathe.

GUARANTEE.

We guarantee this lathe to be equal in workmanship, truth, accuracy, solidity, material and finish, to the best made, and hold ourselves legally liable for this guarantee.

LODGE, DAVIS & CO.

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(See our advertisement on last page.)

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Sizes Varying From **30 to 2000 Horse Power.**

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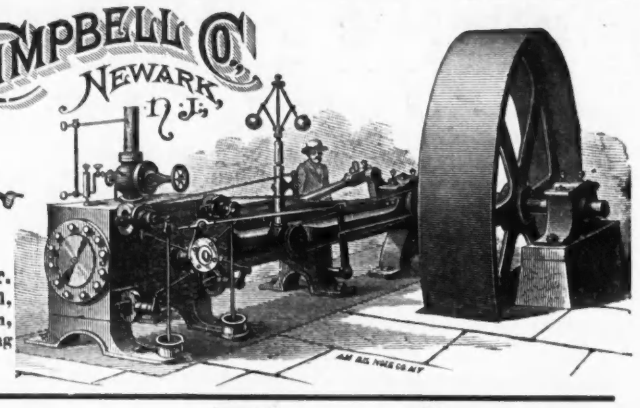

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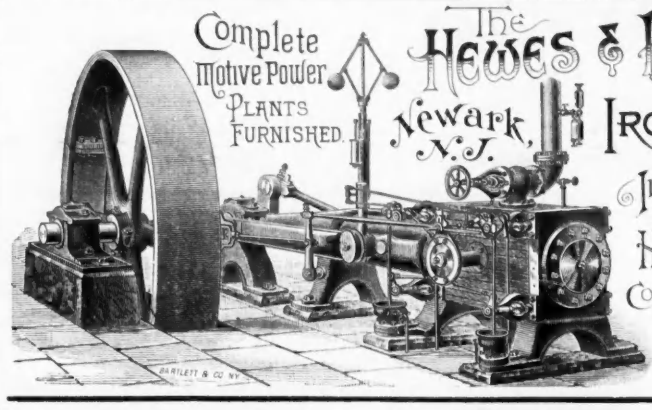

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Improved CORLISS ENGINES.
High Pressure.
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FISHKILL CORLISS ENGINE

BUILT BY THE FISHKILL LANDING MACHINE CO.,

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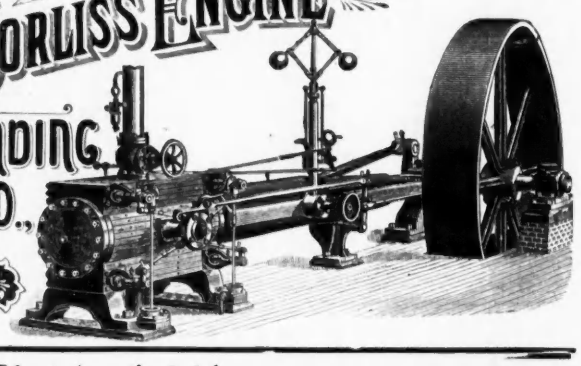

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ALSO SLIDE VALVE ENGINES
STATIONARY BOILERS,
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Room 6,
COAL AND IRON EXCHANGE,
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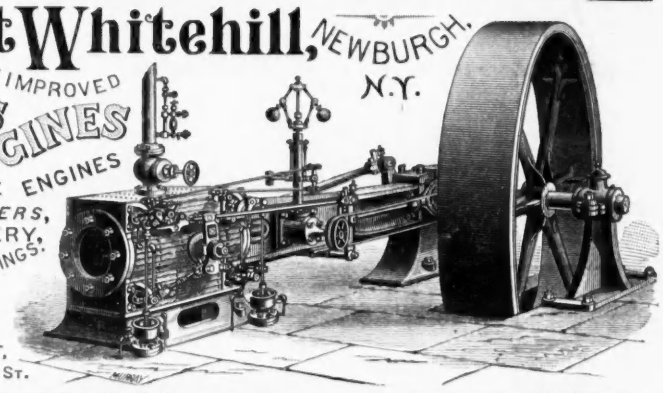

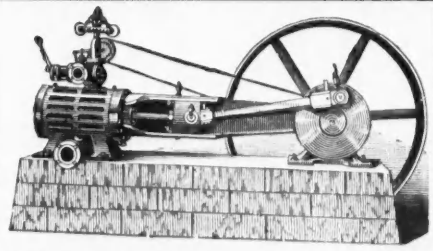

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Engines from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

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WE ARE MAKING A SPECIALTY OF A 24-INCH LATHE, WITH BED ANY LENGTH DESIRED. THIS LATHE IS DESIGNED FOR SEVERE SERVICE; IT IS THE HEAVIEST OF ITS SIZE EVER PRODUCED, AND THE WORKMANSHIP AS GOOD AS SKILL CAN MAKE IT.

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BUILDER OF

CORLISS ENGINES,

AIR COMPRESSORS AND BOILERS.

FLATHER PLANERS

NEW PATTERNS.
LATEST IMPROVEMENTS.
SPLENDID WORKMANSHIP.

GUARANTEE TO GIVE SATISFACTION TO THE BEST MECHANICS.

SIZES ON HAND:

One to plane 26″x26″x6 ft.
One to plane 26″x26″x8 ft.

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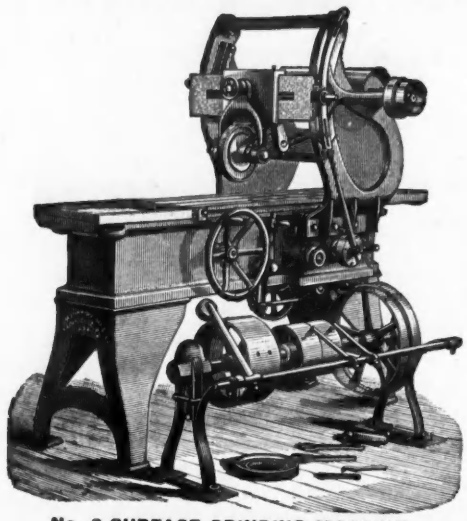

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Manufacturers of

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This Machine is designed for flat and true surface grinding and finishing. It is an effective substitute for the operations of filing and stoning. The entire cost of files, and three-quarters of the labor usually expended on these operations are saved, beside obtaining better surfaces upon the work done. For all finished parts of machinery of cast iron or steel, hard or soft, for punches or dies, straight edges, flattening dies, etc , it will prove invaluable, and will produce fine work with little expense.

It will Grind 14" wide, 36" long, 10" high, using a 9 ' wheel.

The countershaft has tight and loose pulleys 8" diam., 4 ' face, and should run about 276 turns per minute.

Price includes countershaft, wrenches, etc., all complete, delivered F. O. B. at Providence, R. I. Weight, 2,500 lbs.

We are prepared to furnish this machine lengthened, to grind 5 ft. long. Weight, 3,000 lbs.

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NILES TOOL WORKS.
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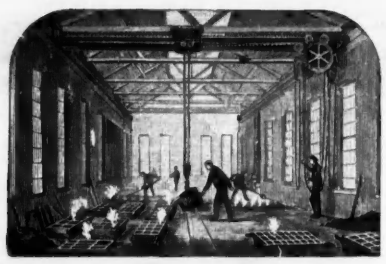
—FOR FOUNDRY USE.—



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Particulars on application. Full Specifications and Tender promptly submitted on receipt of capacity and span of bridge desired.

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20-INCH LEVER DRILL.

20 in. Upright Drill
24 " " "
26 " Back Geared and
30 " Power Feed
38 " Drills.

26-INCH BACK GEARED AND POWER FEED DRILL.

LODGE, DAVIS & CO.
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Send For Prices. It Will Pay You.

(See special notice of Engine Lathes on page 15.)

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Eberhardt's New Drill

Turns out 20 per cent. more work than any other.

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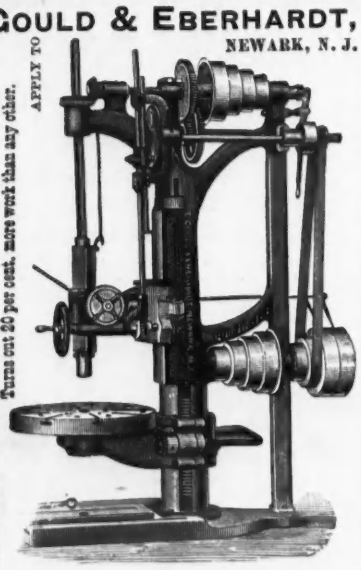

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Drill Presses, Hand Lathes, &c.

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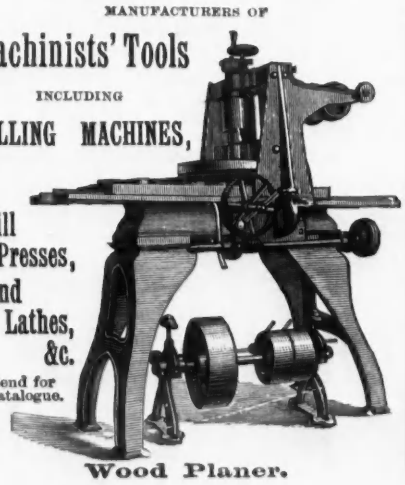

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THE PRATT & WHITNEY CO.,

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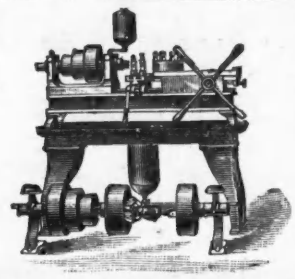
HORIZONTAL

Boring Mills,

48 in. and 66 in. Swing.



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For ⅝ in., 3 in. and smaller holes.

Revolving Head Drilling Machines.

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DROP FORGINGS IN COPPER, IRON OR STEEL.

Pure Copper Commutator Bars for Electric Motors or Generators, Steel Commutator Rings and Nuts, Steel Wrenches and Eye Bolts.

DROP FORGINGS FROM PURE COPPER.
THE BILLINGS & SPENCER CO. HARTFORD, CONN.

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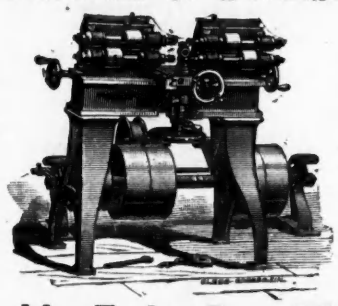

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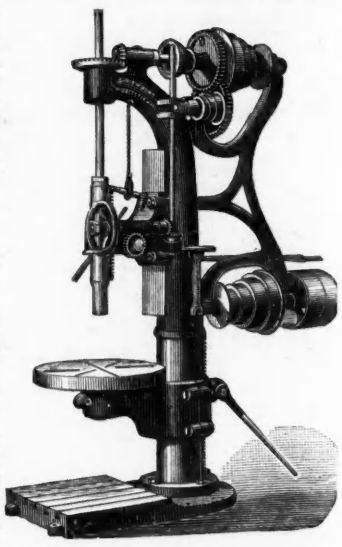

Engine Lathes, Planers, Drills, Etc.,
Pond Machine Tool Co., Successors to **David W. Pond,**
New Designs, Quick Delivery, Great Variety. WORCESTER, MASS.

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FROM 16 to 48 IN. SWING.

Cuts, Photographs and Prices furnished on application.

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KEY SEATING MACHINES
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20 in. Drills a specialty.

Our 20 in. Drill is a heavy substantial tool, made for service, has steel shafts and spindle. Gears and racks cut from the solid and have all modern improvements, are made by special machinery, and sold very low.

Our Key Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment, both Key Seat Machines and 20 in. Drills. Send for Photo. and Catalogue.

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Lathes, 17 in.
Planers 24"x24"
30"x30"

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We desire to express our thanks for the liberal patronage bestowed upon us in the past, and respectfully solicit a continuance of the same.

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